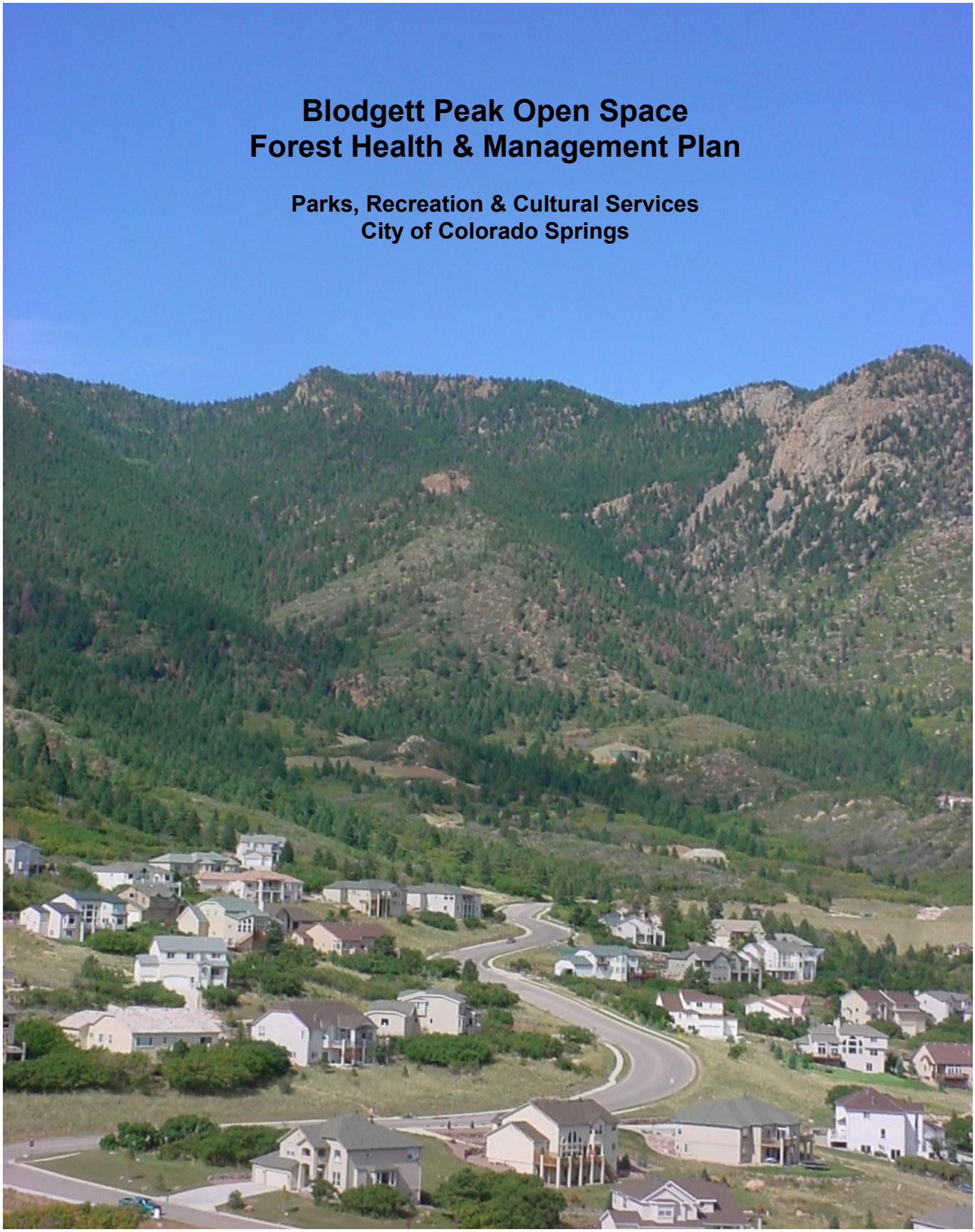
Blodgett Peak Open Space
Forest Health & Management Plan

Parks, Recreation & Cultural Services
City of Colorado Springs



Blodgett Peak Open Space

FOREST HEALTH & MANAGEMENT PLAN

City of Colorado Springs
Parks, Recreation & Cultural Services
1401 Recreation Way
Colorado Springs, CO 80905
(719) 385-5940

Tract in SE ¼ NW ¼, SW ¼ NE ¼, NE ¼ SE ¼ & the majority of SE ¼ NE ¼
Section 4
T13S R67W 6th Principal Meridian - Colorado

Assessor's Parcel Number
Parcel ID # 73000-00-477
El Paso County, Colorado

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September, 2003

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Executive Summary

The Blodgett Peak Open Space was added to the City of Colorado Springs Park's system in 2001. A Master Plan was prepared and a need was determined to develop a forest management plan to provide for the preservation and conservation of the natural resources. This document is intended to serve as a guide to the restoration and renewal of the declining health in the forest community.

Steep slopes above old road

The major threats to the continued health of the forest community include a severe dwarf mistletoe infection in the Douglas-fir. Noxious weeds are spreading from the access road into the riparian area of Dry Creek and other locations within the open space. The threat of loss from wildfire is extreme due to the flammable scrub oak and steep slopes in the western portion of the open space.

The factors affecting forest management activities are the steep slopes in excess of 30% which cover over 60% of the open space. The soils that cover these slopes are highly erodible if disturbed. Access to the west portion of the open space is poor although an old road that crosses private and public property could be utilized.

Dwarf Mistletoe in Douglas-fir

The opportunities for forest community improvement are many fold. The top priority is to control and eliminate the noxious weeds in the open space. The second priority is to remove the fir with the highest level of dwarf mistletoe infestation.

A small area of ponderosa pine should be restored and maintained in an old growth state through the use of thinning and prescribed fire.

The large acreage of scrub oak should be reduced and restored to an open pine forest type.

All management activities need to provide a positive response to other considerations such as wildlife, landscape views and recreation.

INTRODUCTION

The Blodgett Peak Open Space was purchased and added to the park system of the City of Colorado Springs in 2001. It comprises 168 acres of four vegetation types, scrub oak, scrub oak/ponderosa pine, disturbed corridor and Douglas-fir.

The intent of this forest management plan is to supply the information needed to provide "effective conservation and management…" to "protect the integrity of its (Blodgett Peak Open Space) resource values". This theme was stated and reinforced throughout the master plan approved in September of 2002.

As stated in the Blodgett Peak Open Space Master Plan, the ecological goals are first to "preserve "the natural resources of the open space. This goal is to be accomplished by basing
"all decisions on through resource documentation" and through "understanding the interrelationships" between the "natural systems" within the open space. Specifically, this includes the "preservation and protection of the conservation values of the property as described in the Baseline Inventory." This management plan includes an examination of the following conservation values:

- Visual Management & Viewshed
- Wildlife and Sensitive Species
- Recreation
- Forest Insects and Diseases
- Forest Health & Water Quality
- Wildfire

The second ecological goal is to "promote the conservation and restoration of natural communities. This goal includes "encouraging the natural occurring functions and processes that enhance and regenerate the ecosystem and the biological diversity that it supports." Also within this goal is "preventing degradation" and "encouraging restoration of degraded areas" along with educating the public about the "ecological consequences of visiting the area."

Based upon the initial reconnaissance of the property and consultation with the appropriate parties and public agencies and the results of the field inventory the following recommendations are made:

Recommendations

1. Improve the overall health of the coniferous forest through the control of dwarf mistletoe.

2. Control the spread of noxious weeds and their escape from the utility access road and right-of-way into the forest and shrub lands.

3. Lower the extreme wildfire hazard where exposure to loss exists on private property.

4. Increase ponderosa pine stocking levels through pine type restoration, particularly in the south half of the property.

General Description and Discussion

The elevation of the property ranges from 8184 feet above sea level on a ridgeline in the North West corner of the property to 7054 feet above sea level at the main trailhead located along Woodmen Road.

The property borders a wide drainage basin to the south which has Gambel oak as its main vegetative cover. There is an old jeep track that could provide access to the southwest area of the open space property. This potential access crosses both private and public lands.

The drainage of the property originates in the Rampart Range to the west and flows to the east, ultimately into Monument Creek and the Arkansas River system.
The slopes on the west portion of the park readily exceed 30% and can reach upwards of 60% in some locations. These steep slopes will play a significant role in restricting forest management treatments.

Northwest of the park, Blodgett Peak dominates the topography with its steep and exposed rocky slopes. A portion of the south facing slope depicts an example of challenges faced in this region. The area in question is actively eroding and has no vegetative cover. Severe disturbances in this region can lead to a condition that cannot be easily reversed. This condition could also represent an example of the result of a “do nothing” approach in regard to forest health and management treatments.

The United States Geological Service describes this area as being a montane forest. These forests, dominated by evergreen, needle-leafed trees, occupy a belt at intermediate elevations on the east side of the Rocky Mountains. This “montane forest” lies between the woodlands of the lower elevations, and the dense forest “sub-alpine” just below the upper limits of tree growth.

South and west-facing slopes below 8,200 ft. are commonly dominated by ponderosa pine. There are also some stands in which the dominants are junipers, lodgepole pine, limber pine and aspen. On the opposite slopes, Douglas-fir can be found as a dominant stand or as a mixed stand with ponderosa pine.

The density of the shrub and forb under story is inversely related to the density of the tree crowns. As the canopy cover decreases, the cover of shrubs and forbs increases. Mountain-mahogany, Gambel oak and skunkbush are common in the open forest while squaw current is the most common shrub under ponderosa pine. Kinnikinnik and waxflower are common in the Douglas-fir stands.

There is considerable variation in the density of the vegetation in the montane forest although the species of plants is rather constant from one stand to the next. In order to distinguish between these variations in density, the “montane forest” is subdivided on the basis of the percentage of the ground covered by tree crowns. Those stands with trees covering less than 65% of the ground are considered “open-montane forest”;

those stands with density of crowns exceeding 65% are considered “closed-montane forests”. The Blodgett Open space contains both types of montane forest.

The typical weather experienced in the area shows a yearly temperature average of 48 degrees. The average daily maximum reaches approximately 62 degrees with the average daily minimum temperature falling to 35 degrees. There is an approximate growing season of 125 days per year.

Precipitation levels range from 11 to 20 inches per year. Annual snowfall averages 41 inches per year. The last spring frost usually occurs around the middle to latter part of May with the first freeze in the fall occurring around the latter portion of September.

Visual Management Considerations

The effect of any management activities needs to encompass the impact on the view shed from the perspective of the foothills back drop to an individual view of the activity.

The impact any management activity may have on the foothill visual esthetic of the Blodgett Peak Open Space is not an issue for concern. Photo 1 provides a view from the eastern part of the city towards the foothills.

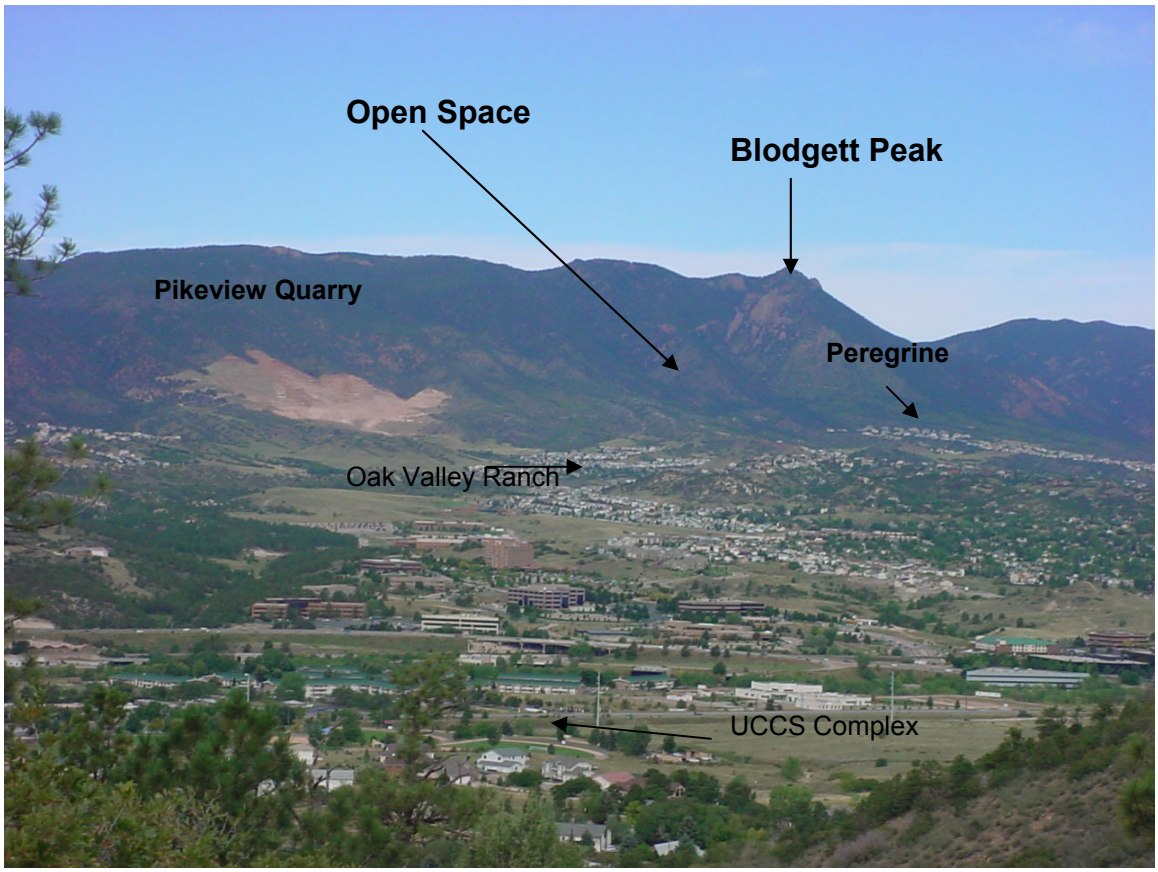


Photo 1.

This landscape view was taken from the Garden Ranch area of Colorado Springs on the bluffs overlooking the University of Colorado – Colorado Springs campus and Austin Bluffs Park.
In the larger landscape picture, any type of management activity will be virtually unnoticed within this view.

Photo 2 brings the local neighborhood view into account. This landscape view was taken from where Woodmen Road changes to Centennial Boulevard. Again, the majority of management activities will not have a negative effect on the esthetic visual values the open space provides.

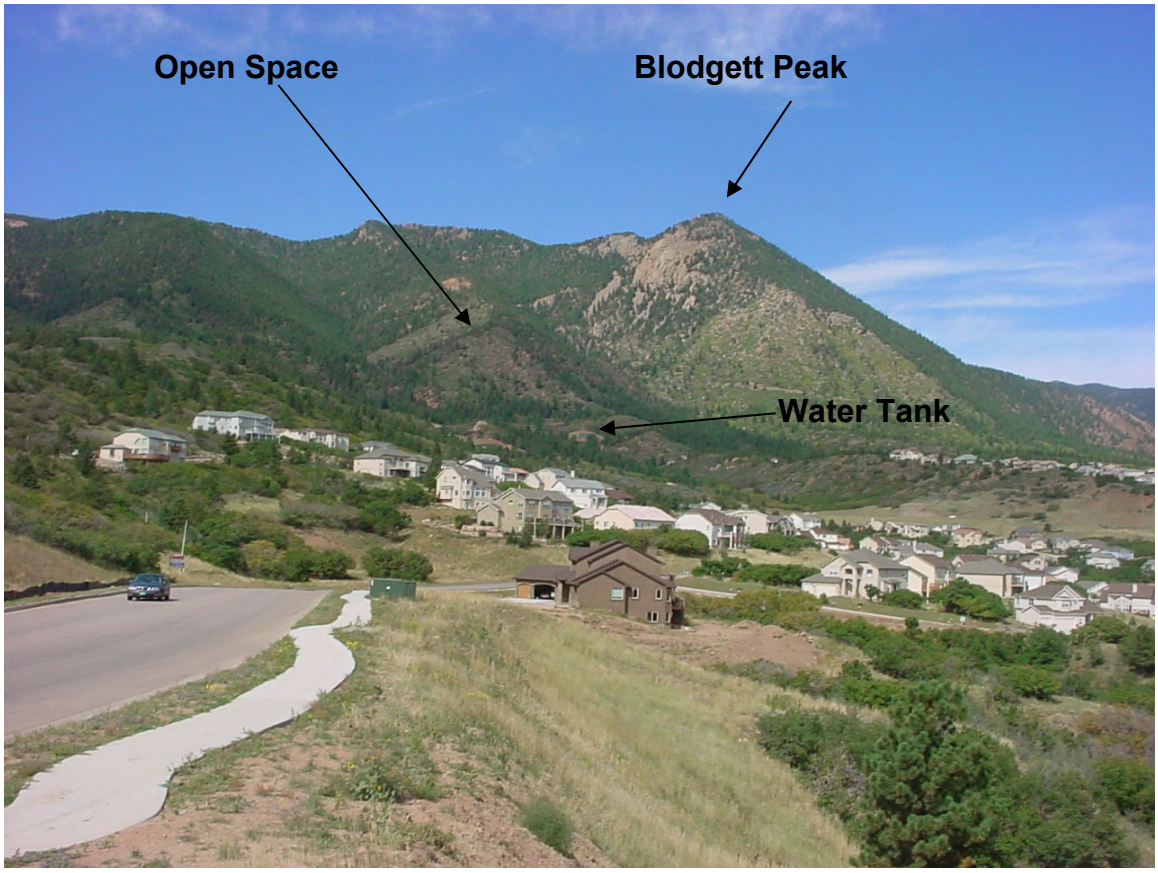
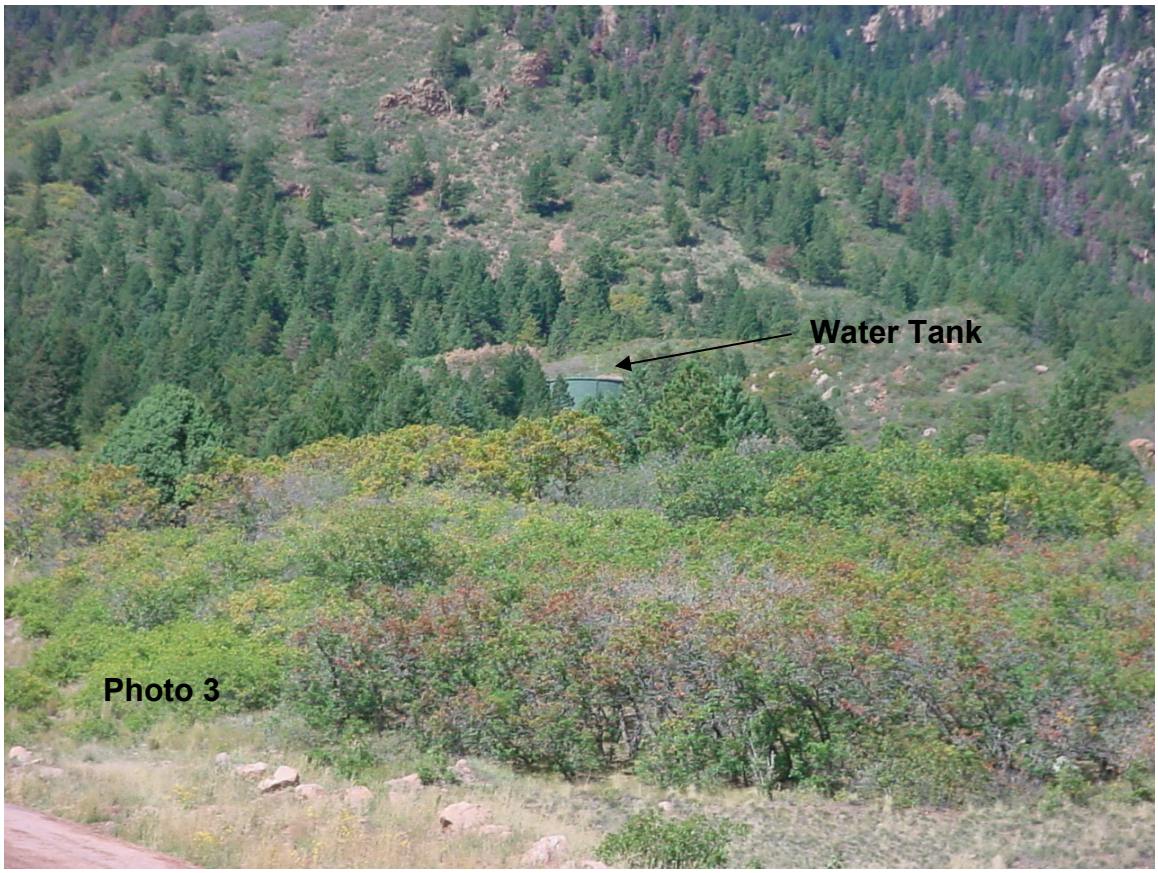


Photo 2.

A close –up examination of the view within the open space provides a different perspective. The largest impact to views within the park is the location of the utility water tank. Even though the color of the tank does not blend entirely into the landscape, enough time has passed for the native vegetation to start to influence the view of this man-made feature. Photo 3 shows a view towards the water tank from the trailhead and parking area. The influence of the vegetation is readily apparent. As the conifers continue to grow, the view of the tank will disappear. Management activities in this locale must not interfere with the closure of the view of the water tank.



A view of the water tank from the utility access road is depicted in Photo 4. This view is taken looking north from the Dry Creek drainage. As one comes up the road the tree line to the east conceals the water tank from immediate view. The vegetation in the scrub oak zone at this locale should not be disturbed at all. Single Douglas-fir or ponderosa pine trees or small islands of trees should be planted to help further conceal the water tank from immediate view.

Obviously, as one continues to the north along the access, this feature cannot be hidden.

Photo 4

Trail Considerations

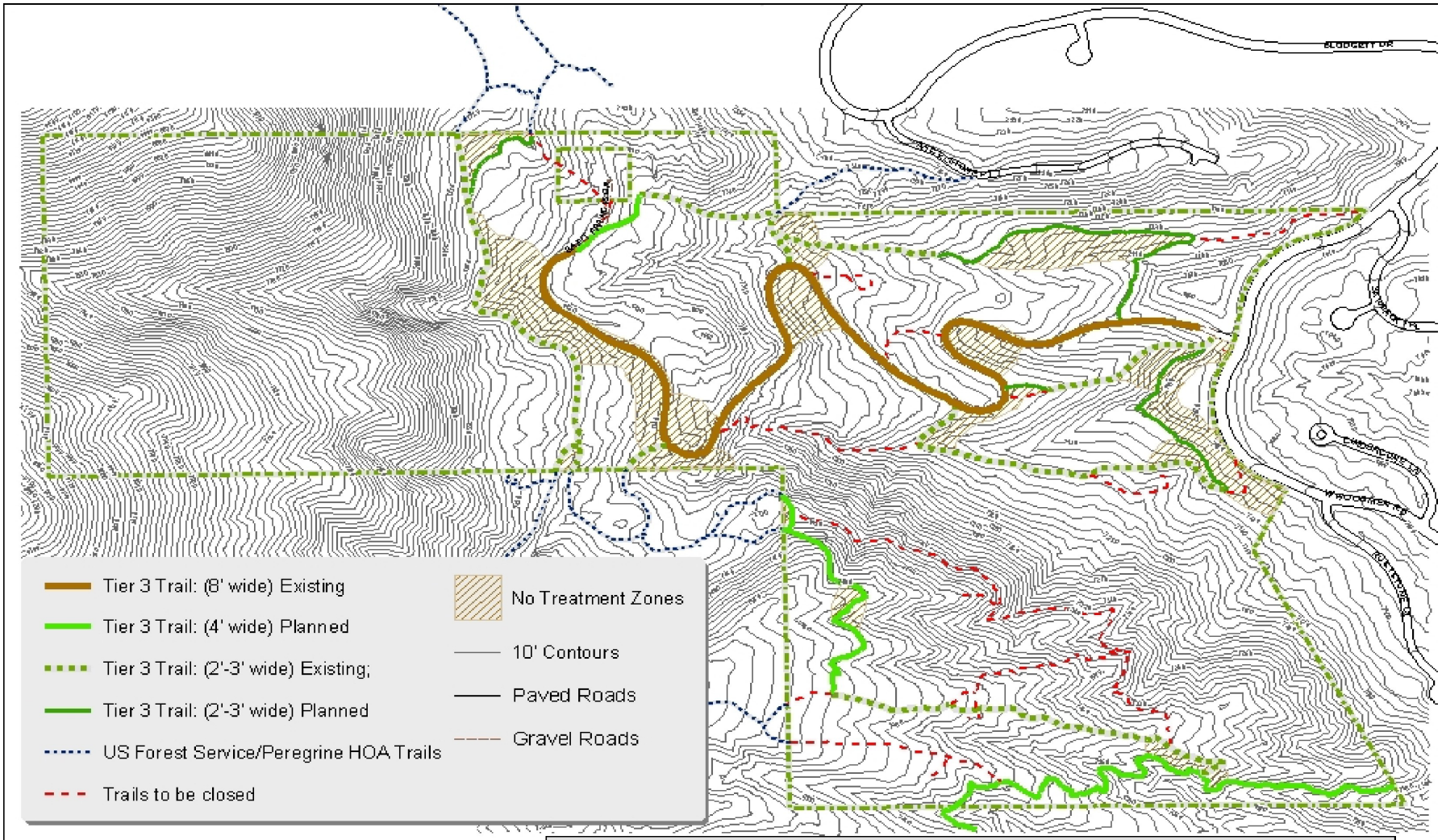
The existing and proposed trails cross through a number of locations in the eastern half of the open space. All vegetation zones will experience some level of impact from this recreational activity.

The biggest impact of trails and their use is the development of social trails that provide shortcuts from one trail to another. These types of trails can lead to soil erosion, noxious weed spread and loss of vegetation. As social trails are not defined, they can lead to spur trails as individuals determine for themselves which way to travel.

One of the largest risks to this social trail development is along parallel trail and road corridors. If management activities open the access to a neighboring trail or road, the more likely it is that the public will utilize these areas for perceived shortcuts to other trail corridors. An example of this can be seen in Photo 5 below.

Photo 5.

This photo is taken from the old road that is located above the utility access road. The very light colored space in the center of the photo (see arrows) is the utility access road itself. It would not require any large disturbance of this understory to provide an avenue for social trail development. Therefore, management activities must consider the long-term impact on the
trail system within the open space. Map 1 provides the location of areas that have a high sensitivity in this regard.



Map 1: Recreational Trail Impact Areas

CITY OF COLORADO SPRINGS
Parks, Recreation & Cultural Services

N
SCALE:
1 " equals 500 '
0 500
Feet

BLODGETT PEAK OPEN SPACE

MAP VERSION: 09-24-2003
Lower Left: 3170350, 1404590
Upper Right: 3175350, 1408215

State Plane Coordinates
Colorado Central Zone

NAD83 - US Survey Feet
Vertical Datum - NGVD29

Wildlife & Sensitive Species Considerations

There are a number of wildlife species that use the open space for limited times during the year. The mule deer (Photo 6) appear to use many parts of the open space for grazing, shelter and birthing. There are a number of game trails throughout the property that attest to this type of use.

There does not appear to be any long time period use of the property that would label it as being significant or critical habitat. No locations could be found where feeding on the vegetation was heavy enough to consider any area as critical winter habitat. Due to the relatively thin conifer cover, the area does not provide superior thermal winter protection. However, the thin canopy may supply adequate day time resting cover during the winter.

Photo 6. Mule deer grazing in drainage channel within the Douglas-fir Zone.

Any activity that removes the thick scrub oak cover will improve the quality of the habitat for mule deer. Increasing the grassland component of the open space will provide sheltered feeding sites. This in turn may relieve the feeding pressure of the deer being experienced on private land in the local vicinity.

There is activity from black bears noticeable within the open space boundary. The intermittent creek corridor seems to be a preferred use location. It provides daytime

resting cover during the summer months and a late season food source in the fall. There also appears to be a winter den site further up into the steep drainage of Dry Creek. As the den site is located in a rugged location of the open space, no wildlife management considerations are necessary at this time.

Wild turkeys are visitors to the open space although they were not observed during the inventory. The Merriam's wild turkey is found primarily in open meadows and in scrub oak and ponderosa pine stands in the mountainous zones of the Front Range. Turkeys prefer large crowned ponderosa pine as evening resting cover. This type of habitat is available in the lower southwest section of the open space.

In order for this area to become a preferred habitat location, the scrub oak needs to be removed and an open park-like ponderosa pine vegetation zone established. The availability of scrub oak as a late season food source is adequate enough in the adjacent areas to this location. So the removal of the oak will not harm the habitat resource.

A family of red-tail hawks was observed within the open space during the inventory process.

Buteo jamaicensis
(Red Tailed Hawk)

Photo Courtesy of Schomker.org/BirdPics

Photo 7.

Red tailed hawks are a familiar sight in the Pikes Peak region. It is the most widespread member of the large soaring hawks. Red tailed hawks prefer forested locations with high perching sites. These locations need to have open areas, such as meadows, nearby.

Their diet of mostly small mammals such as ground squirrels, pocket gophers and other such rodents inhabit these grasslands. Although this raptor is not threatened or endangered, it is protected under the Migratory Bird Treaty Act.

Threatened and Endangered Species

The U.S. Fish and Wildlife Service list the following species for El Paso County that could have the potential of visiting on the open space:

American peregrine falcon, Falco peregrinus, Endangered
Bald Eagle, Haliaeetus leucocephalus, Threatened
Northern goshawk, Accipiter gentilis, Category 2
Whooping Crane, Grus Americana, Endangered
Greenback Cutthroat Trout, Salmo clarki stomias, Threatened
Piping Plover, Charadrius melodus, Threatened
Mexican spotted owl, Strix occidentalis lucida, Threatened
Loggerhead shrike, Lanius ludovicianus, Category 2
Boreal toad, Bufo boreas boreas, Category 2
Regal fritillary butterfly, Speyeria idalia, Category 2
Lost ethmiid moth, Ethmia monachella, Category 2

The following plants are listed:

Bell's twinpod, Physaria bellii, Category 2
Larimer aletes, aletes humilis, Category 2
Pale moonwort, Botrichium pallidum, Category 2
Purple lady's slipper orchid, Cypripedium fasciculatum, Category 2

There were no endangered species found or observed during the inventory process.

Noxious Weeds

Of the over sixty noxious weeds listed by the Colorado Department of Agriculture, four of the ten priority noxious weeds are found within the open space. They are Canada thistle, musk thistle, diffuse knapweed and yellow toadflax.

Noxious weeds typically inhabit disturbed sites such as dirt roads, trails and the like. As would be expected, the largest contributor to the noxious weed population is the disturbed corridor (see Photo 8) along the utility access road and the road spoil piles.

Photo 8. An example of Canada thistle with mature seed heads along utility access road. Note the exposed soil created from road maintenance activity. This creates a favorable seed bed for thistle infestation.

The infestation of noxious weeds along the utility access road and spoil dumps is the prime source of seed for dispersal to other parts of the park (see Photo 10). This condition was noted in the master plan as an ongoing concern, particularly in regard to Canada thistle, diffuse knapweed and musk thistle.

During the inventory process, the Canada thistle has been found outside the boundary of its current habitat along the utility access road. Canada thistle was found in the intermittent Dry Creek channel adjacent to one of the spoil piles (see Photo 9), at a disturbed site along the hiking trail/old road above the utility access road, in the utility corridor lying east of the water tank, and on one of the old roads that is being utilized as a trail corridor. Approximate locations of noxious weed distribution can be found on Map 2.

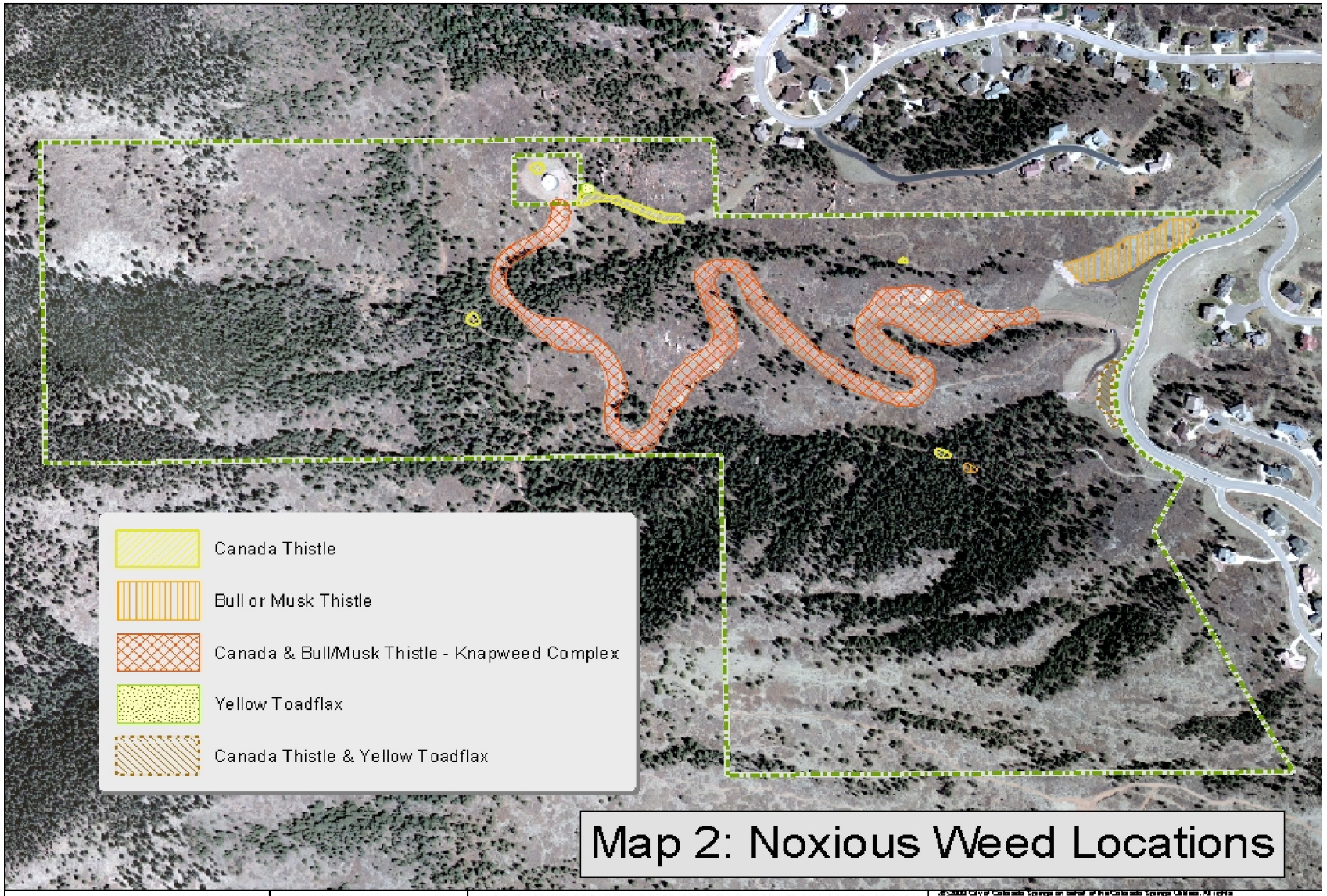


Photo 9. Canada thistle with mature seed heads in the stream channel of Dry Creek.

As these new infestations of Canada thistle are relatively small in size and are found within the stream channel of Dry Creek, control measures should be implemented immediately. Failure to take quick action may well result in the permanent establishment of Canada thistle in this wetland area and the loss of native vegetation such as Monarda fistulosa (Wild Bergamot).

An aggressive approach should be taken to control the noxious weeds within the disturbance corridor of the utility access road. At this point there has not been a serious migration of these weeds outside of the disturbance corridor. Due to the ease in reaching this location to treat these noxious weeds, this should become the number one management priority.

Musk thistle was found in the disturbance corridor and on the slopes above the constructed drainage impoundment areas. As musk thistle is a biennial plant and reproduces only by seed, it can be readily controlled by removing the seed head before it matures. It is suggested here that a volunteer force be recruited to remove the seed heads from the thistle in the drainage impoundment area. Again, the area of infestation is relatively small and would require only a small expenditure of resources on an annual basis to eradicate this weed from the park on a permanent basis.

Photo 10. Another example of Canada thistle and knapweed (just to the left and outside of the photograph) at a culvert crossing of Dry Creek. Water (blue arrow) is flowing through the creek and it will carry seed down stream.

Appendix Four contains details on each of the four noxious weeds found within the park. These detail sheets were produced by the Colorado State University Extension Office. Included within these detail sheets are the most current best management practices and approaches to control. These sheets can be reviewed for updated control strategies and the disposition of chemical control agents via the Internet at www.ext.colostate.edu/ptlk/2103.html. From this location, there are links to other Extension pages that discuss the specifics of the noxious weeds.

Points of Contact for state and local noxious weed information are:

Mr. Eric Lane – State Weed Coordinator; (303) 239-4182
Mr. Bob Overman – El Paso County Coordinator; (719) 575-8490

Historic Land Use

The basic history of the area is similar to most along the Front Range of Colorado. The area had been part of ranches that have since been subdivided to accommodate the movement of urban dwellers to a more rural living situation. The recent economic boom in the Colorado Springs metro area and subsequent spill over into Teller and Park counties has only accelerated this process.

Wildfires have been part of the ecosystem throughout the history of the area. Typically small low intensity ground fires maintained the ponderosa pine stands in an open park-like condition. However, there is evidence of a catastrophic wildfire event. This event probably occurred sometime in the 1870's to the1890's.

Successive years brought the advent of fire suppression throughout the west. Continued suppression activities have allowed a buildup of forest fuel resulting in catastrophic fires and property loss. The Hayman Fire in northern Teller County typified the result of this suppression process in the summer of 2002.

In addition, the suppression of wildfire has significantly altered the stand development pattern of most Front Range forests. Compared to ponderosa pine, Douglas-fir is substantially less tolerant of arid conditions and more tolerant of shade. As seedlings of Douglas-fir become established under the ponderosa pine canopy, they will replace the ponderosa pine in the overstory if there is an absence of periodic fires or other such disturbances. While this condition leads to a higher risk of catastrophic wildfire, it also supports conditions that can lead to major infestations of western spruce budworm. This was the case in the early to mid 1980's when an outbreak of budworm severely defoliated thousands of acres in Teller and Park counties.

The increased urbanization of the area does not appear to be slowing. Managed tracts such as the Blodgett Peak Open Space will help provide breaks in the long line of fuels particularly as it is adjacent to other private tracts of land, the Pike National Forest and the U.S. Air Force Academy.

The following aerial photo provides a glimpse of the conditions that existed within the open space and in the surrounding area. This photo was taken in August of 1955. The second aerial photograph shows the condition of the area in 1997. Points labeled A, B, C and D mark reference locations between the two aerial photographs. The numbers with arrows are areas of comparison over the forty-two year period.

In the 1955 aerial photograph, the areas that are very light, almost white in color, depict exposed soil or a disturbed location. The light gray color is grassland or meadows. The darker hued gray color is scrub oak. The darker dots with a black shadow to the northeast are conifers. The vegetation in the color aerial photo is self explanatory.

One of the most noticeable differences is the amount of residential development that has occurred. The two reservoirs have disappeared over the time frame the aerial photos provide. The water tank (6) has yet to be constructed in the 1995 aerial photo. Arrow 1 shows the drainage channel for Dry Creek. Conifers are virtually absent form the creek until the old road (C) is reached in the 1955 photo. Today, the fir is quite dense along the channel and trees reach all the way to the storm water detention pond.

Arrow 2 indicates areas of the open space that were formerly open grassland that are now covered in scrub oak. Arrow 3 shows where open fir/pine has closed its canopy, eliminating either grass meadows or scrub oak in the southern portion of the open space.

Arrow 4 shows the area immediately west of the old road where it turns off of the utility access road. This area has conifers in it, but with a very open canopy closure. In the later photo this area has a closed canopy cover.

Arrow 5 is the location of the hill between the curves of the utility access road. In 1955, the area has scattered conifers with an open oak cover. The colored aerial photograph shows this area having a closed conifer canopy. There is virtually complete cover of oak where the open grassland and exposed soil formerly existed.

It is important to realize that change has occurred on the open space and that this change will continue. A long term prediction is that barring any major disturbance, such as a wildfire, the area will eventually transform into a Douglas-fir forest. Another observation is how short of a time it takes for changes to occur. In spite of the semi-arid conditions that exist that would seem to limit the establishment and growth of trees, significant changes can occur within a very short period of time. The comparison of the aerial photographs would seem to endorse this observation.

SOILS

Soils are the basic building blocks of vegetation growth. There are six primary factors that are generally recognized as controlling plant growth. They are light, mechanical support, heat, air, water and nutrients. The soil is an agent that is involved either directly or indirectly in supplying these factors with the exception of light.

The soils found within the Blodgett Open Space Park, coupled with the degree of slope found in its overall topographic features, will impact the degree and method of forest management activities. While a discussion of the soils found in the open space is in the master plan, a further review is warranted here due to the effect the soils will have on the forest management recommendations.

There are three main soil types to be found within the Blodgett Open Space perimeter (see Map 3). At the higher elevations, the Legault soil type is found. The mid-slope areas contain the Sphinx-Rock Outcrop Complex. The remaining soil type, Tecolote, is found in the small basin above the trail head and in the southeast corner of the park. A brief description of each soil type is provided below.

Legault Soil Type

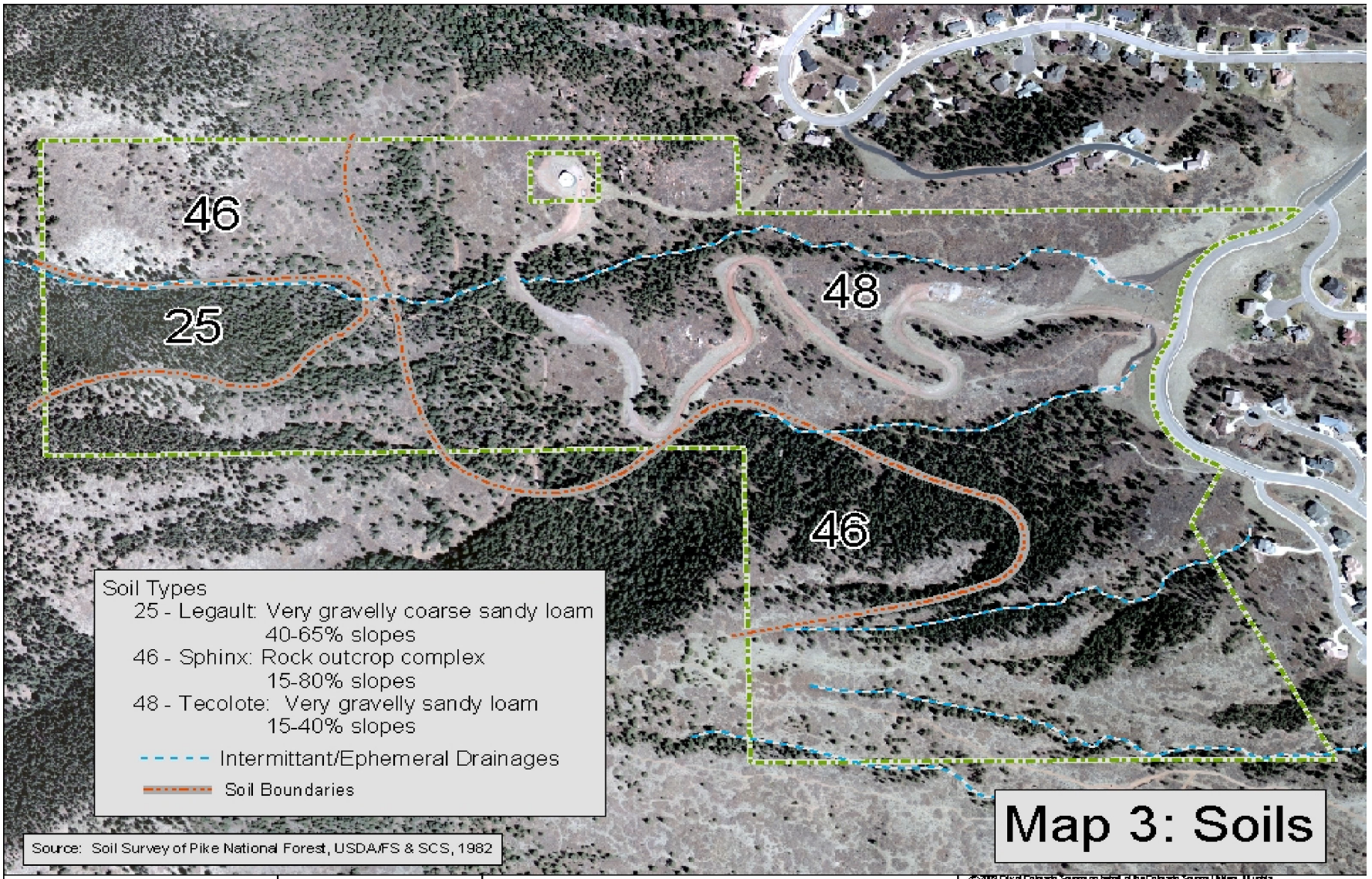
The Legault very gravelly coarse sandy loam unit is found on slopes ranging from 40 to 65 percent in steepness. It typically exhibits itself on north facing slopes at elevations between 8,000 to 9,800 feet. This soil material is composed of material weathered from Pikes Peak granite.

This soil type is highly susceptible to erosion if the surface is disturbed, with the hazard from water erosion being severe. The soil is relatively shallow, ranging downward to 17 inches in depth, so this soil tends to have a very slow infiltration rate when it is thoroughly wet. This results in runoff from storms to be very rapid.

Organic matter content is very low ranging from 0.5 to 1% of the two inch surface area. Fine soil particles or clays comprise only 5-10% of the upper eight inches of the soil. So again due to relative absence of small soil particles to bond the matrix together, this soil is highly erosive, particularly when exposed to the forces of water.

The dominant vegetation on this soil type is Douglas-fir. It is not uncommon to find an understory of aspen, kinnikinnick, grasses and forbs. The average annual production of wood fiber is 24 cubic feet (approximately ¼ cord of fuelwood) per acre. The average annual production of air-dry vegetation ranges from 150 – 250 pounds per acre. Mean site index for Douglas-fir is 40.

The major factors that this soil type poses to management are low available water holding capacity, shallow depth to bedrock and the steepness of the slopes where this soil is found.



Sphinx-Rock Outcrop Complex

The second soil type is the Sphinx-Rock outcrop complex found on slopes ranging from 15 to 80 percent. This soil unit is composed of 60 percent of the Sphinx gravelly coarse sandy loam (cool) and 25 percent of rock outcrop which is Pikes Peak granite. This soil type exhibits many of the features discussed in the Legault type above.

The two soils types are very similar. Both are based on granite parent material and share very low water holding capacities and high drainage capability. Runoff tends to be very rapid during precipitation events. The hazard of water erosion in the absence of plant cover can be extremely high.

One difference between the two types is that the surface layer depth is deeper, but not substantially so with only a four inch depth. But this layer has a higher percentage of clay content ranging up to 15% and almost double the organic matter. The bedrock layer is soft, being composed of highly weathered, coarsely grained granite, which allows for a greater rooting depth potential.

The increased depth of the initial soil layer results in the vegetative and litter layer covering 40 -60% of the surface. The average annual production of air-dry vegetation is almost double, ranging from 150 – 300 pounds per acre. While ponderosa pine is most suited for this soil type, Douglas-fir can readily be found on this soil type as well.

The major factors that this soil poses to management are the same as those mentioned in the Legault soil type with an additional factor of rock outcrop limiting physical movement through the area.

The rock outcrop is in the form of cliffs ranging in height from ten to twenty-five feet and ledges and crags up to five feet high. It can also include the stony and boulder outcroppings of granite or bare exposed outcrop slabs.

Tecolote Soil Type

The final soil type is the Tecolote, very gravelly sandy loam, with slopes ranging from 15 – 40 percent. The parentage of this soil is colluvium which is soil material and rock fragments that are moved and deposited at the base of steep slopes. This movement can occur from soil creep, mechanical slides, or water.

Due to the washing of soil down from the slopes, this soil has even greater clay content, reaching upwards of 20% in the first twenty inches of the soil profile. Again, due to the deposition from the slopes, soil depth is substantially deeper, averaging 45 inches in depth, which is 2-3 times deeper than the two previously discussed.

While this soil is much deeper, the higher percentage content of large rock fragments results in a similar well drained soil type and comparable low water holding capacity.

With a higher percentage of fine soil particles, the permeability of the water is lower, lying in the moderate range. With increased fines in the soil, the hazard of water erosion is also lowered to the same level. However, where runoff is rapid, this soil type can be subject to severe sheet erosion and subsequent gullying.

Rock fragments compose anywhere from 5 – 45% of the soil volume and are generally prevalent in the middle layer of the soil, anywhere from 2 – 20 inches in depth.

Forty percent of the ground surface is covered with vegetation, with shrubs such as Gambel oak and mountain mahogany becoming more prevalent and the shrub type may dominate the site if it is disturbed. The addition of this shrub component increases air-dry vegetation to a range of 300 to 600 pounds per acre. Douglas-fir would be the most natural vegetation on the site. With the increase in soil depth, the site index rises slightly to 45 for both Douglas-fir and ponderosa pine.

The major factors that this soil poses to management are the susceptibility to sheet erosion and gullying, low natural fertility and the number of stones. The decrease in the overall slope percentage makes this soil type available for limited forest management activities. But as the upper reaches of this soil type are disturbed, the more susceptible to water erosion it will become.

FOREST INVENTORY

In the Blodgett Open Space Master Plan, the property was divided into four vegetative zones or types (see Map 4). For the purposes of the inventory, these zones were retained and Dry Creek, a minor subunit was added. Some modification in actual location boundaries have occurred in the mapping process but it is not significant in regards to the master plan.

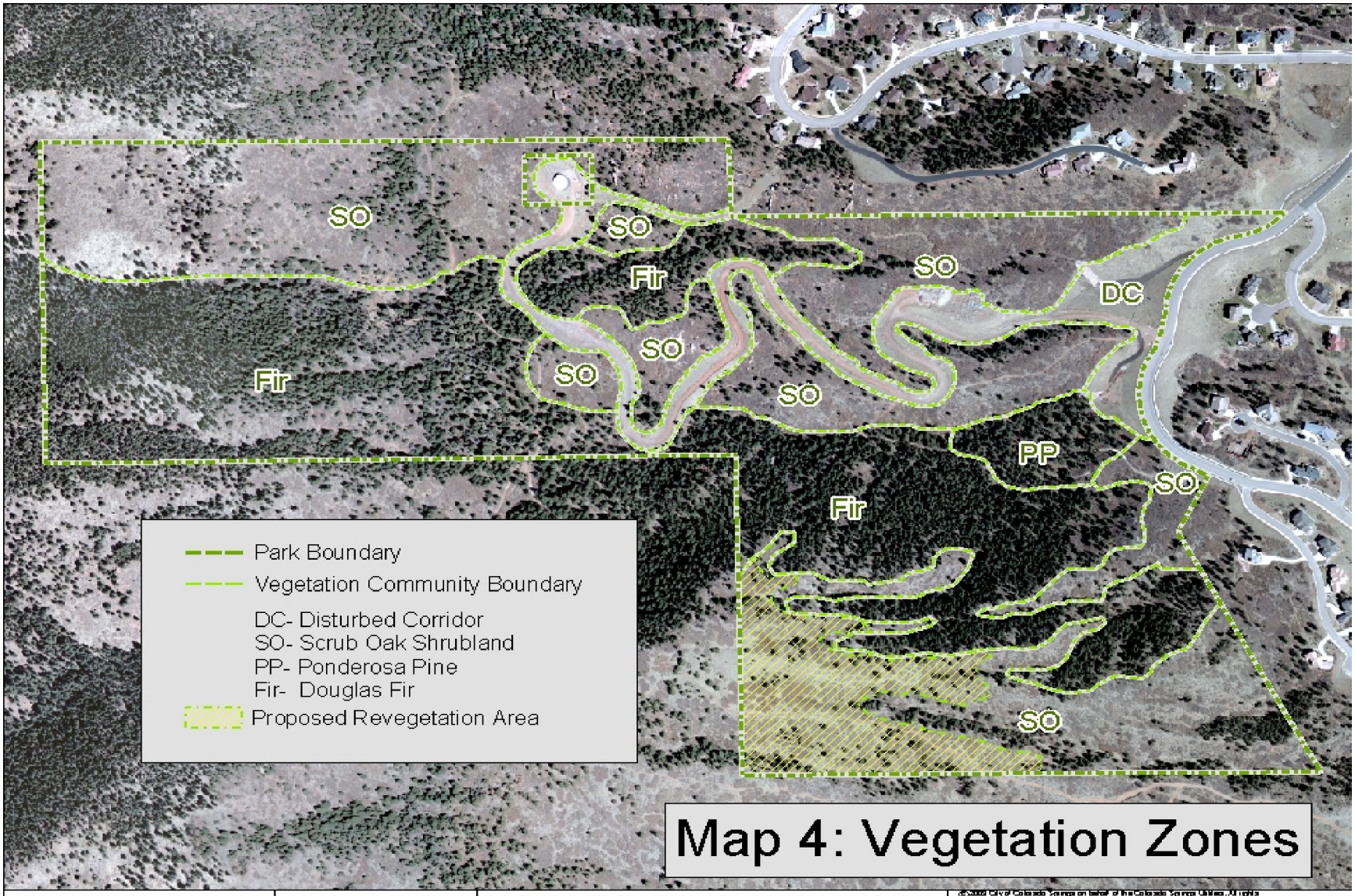
The first vegetation type is identified as the Disturbed Corridor (DC). This area is approximately 14 acres in size and is not forested. This area was the focal point of the Noxious Weed portion of the report. Further commentary will be supplied under the prescription and implementation schedule.

The second vegetative type is called the Scrub Oak Shrub Land (SO). This area could be described as having a shrub species, primarily scrub oak (Quercus gambelli) in this instance, which dominates the land surface. Mountain mahogany (Cercocarpus montanus), wax or squaw current (Ribes cereum) and waxflower (Jamesia americana) are also readily found in this area. These shrub species will comprise upwards of 80% of the plant cover that exists. This is the dominant plant community within the park, having an approximate size of 84 acres.
However, the entire zone is not completely awash in scrub oak. Within this area, both ponderosa pine and Douglas-fir can be found, and to a lesser extent, pinon pine and Rocky Mountain juniper. These conifers may contribute upwards of 20% of the canopy cover in the form of single isolated trees or as small islands of evergreens.

In the third vegetation zone, Ponderosa pine/scrub oak (PP/SO) has the same mix of shrub species dominating the under story as the scrub oak zone. But the ponderosa pine is the dominant overstory tree. It forms a distinct forest canopy and is not found in isolated and distinct islands. The total canopy cover of the ponderosa pine and the shrub species is probably equal on a percentage basis. This shared canopy condition has occurred due to the absence of wildfire. This zone is only 4 acres in size. Normally, an area must contain at least 10 acres to warrant management consideration. In this instance, this zone should be retained to serve as an example of this forest type and as a guide for restoration efforts in other locations of the open space.

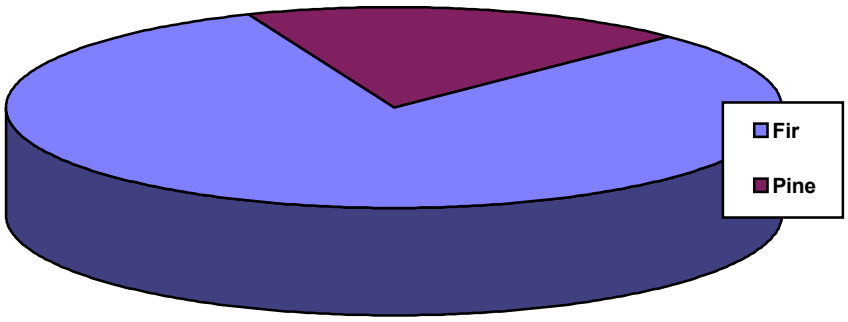
The Douglas-fir (Fir) zone is found on the remaining 66 acres. This vegetative type is found primarily on the north and east facing slopes. On the north facing slopes, white fir can be found within the forest stand along with limber pine or even some ponderosa pine at the top of the slope. Conversely, on east facing slopes, the ponderosa pine can be found more readily with no evidence of white fir present.

From the stand summary of the entire forest area (see Chart 1), species composition is dominated by Douglas-fir, with ponderosa pine only providing approximately 20% of the stems per acre. While present, aspen did not fall within any of the inventory plots. White fir and limber pine were recorded on some inventory plots, but were not separated from the ponderosa pine or Douglas-fir.


SO
SO
Fir
SO
DC
SO
SO
SO
Fir
PP
SO
Fir
SO
Park Boundary
Vegetation Community Boundary
DC- Disturbed Corridor
SO- Scrub Oak Shrubland
PP- Ponderosa Pine
Fir- Douglas Fir
Proposed Revegetation Area
Map 4: Vegetation Zones
CITY OF COLORADO SPRINGS
Parks, Recreation & Cultural Services
N
SCALE:
1 " equals 500 '
0
500
Feet
BLODGETT PEAK OPEN SPACE
MAP VERSION: 09-24-2003
Lower Left: 3170350, 1404590
Upper Right: 3175350, 1408215
State Plane Coordinates
Colorado Central Zone
NAD83 - US Survey Feet
Vertical Datum - NGVD29

Rocky Mountain Juniper and pinon pine were observed outside of the plot boundaries. Table 1 provides the per acre forest inventory summary.

Chart 1: Species Composition of the Blodgett Forest



The average diameter of all trees within the park hovers around 7.8 inches with an average height of 35 feet. The diameter value is of specific interest. When looking at the average diameter comparison between the two species, only a slight difference of 0.3 inches separates them. When other permutations to the inventory data are applied the size of the average ranges from 7.4 inches to 8.5 inches. This fairly narrow range of values indicates that the coniferous portion of the forest is fairly uniform in nature and leads to the conclusion that the coniferous forest is even-aged. To further support this observation, the average height ranges from 29 to 36 feet.

Table 1. Forest Inventory Summary

Average DBH:	7.8 inches
Average # Stems per Acre:	140
Average Basal Area per Acre:	47 (GSL 53*)
Cubic Volume per Acre:	624 (6.9 cords)
Board Foot Volume per Acre:	1812
Site Index:	40

There is no obvious reason for this even age occurrence at first glance. It is suspected that a wildfire may have left an impact on this site. There are several indicators that lead towards this hypothesis. First there are old roots that have been partially buried by soil and litter that when exposed, show small amounts of charred wood. Also within the coniferous forest area, it is rare to find old tree trunks that have slowly decayed into the litter layer of the soil. It is also rare to see a tall stump indicating the presence of historic logging. In fact there is very little woody debris on the forest surface and what is present is very recent in age.

The scrub oak is also an indicator of some past disturbance. There is only one relatively small area of mature oak. This area has oak with main stems having diameters in excess of 3 inches. Their growth form would be described as a small tree and not as a shrub.

* **see Appendix 2 – Glossary, page 67**

There is a distinct canopy and a fairly open understory of shade tolerant forbs and grasses. Foot travel through this stand is relatively easy when compared to a more brushy or shrub growth form.

The majority of the remaining oak stands are small in diameter, described as being less than an inch in diameter and having a very dense growth form more in line with a shrub than that of a small tree. It is extremely difficult to walk through these stands and their stem density is such that it is difficult to readily see through them.

Finally, there is a distinct pattern of lightning scars on existing pines and firs on the upper third of the steep slopes found in the western portion of the park. This indicates that lightning could have been the main ignition source for wildfire. In fact some of the more recent strikes have ignited small fires. These fires have self extinguished either from rainfall during these thunderstorms or from the exposed granitic soils and the relative lack of fine fuels to sustain the growth of these small fires.

Based on this evidence along with the soil types found on this site, it is not improbable that fire crossed this site in the last one hundred years. This conclusion is also based on the inspection of aerial photographs from 1955 (see page 21). The areas now covered with a short oak shrub type on the upper portion of the slopes are devoid of oak in 1955. The lower portions of the slopes do have an oak cover but is more prevalent on the north facing slopes and along Dry Creek. Slopes that face a more southerly aspect are dominated by grass meadows rather than oak shrub. Today, oak dominates this entire area, with very little natural grass meadow left.

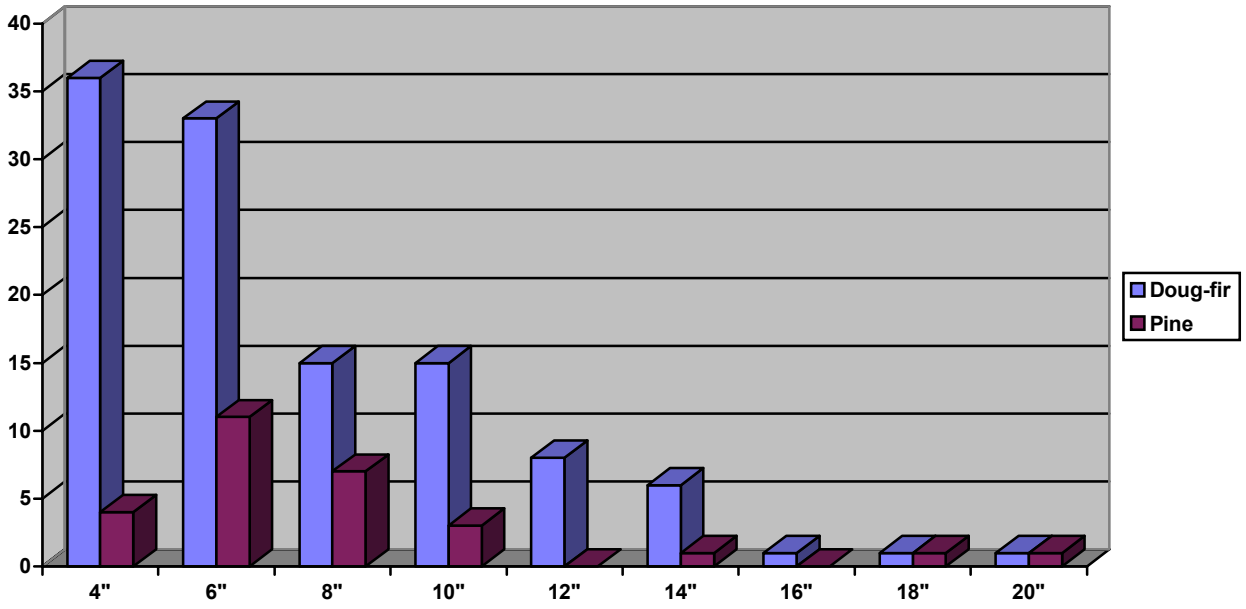
The disparity of vegetation on the steep slopes versus the shallower slope areas in the 1955 photographs can probably be attributed to the soil types that are present. These loose and well drained soils provided a poor growth media for the reestablishment of woody vegetation.

As the early users of the natural resources in the West were not overly conservative, the ponderosa pine would have been reduced in number to such a point that oak regenerated on the site and began to dominate the canopy. The presence of the oak may have provided sufficient cover for the shade tolerant Douglas-fir to gain a foothold.

A close look at the distribution of stem diameter classes visually shows this trend (see Chart 2). At the four and six inch diameter classes, the Douglas-fir is exploiting the current vegetative condition as compared to the pine in excess of 4-1.

This domination lessens somewhat in the middle diameter classes, but not appreciably. As the higher diameter classes are compared, the differences are almost equal. So if both species had the approximately same number of trees to provide seed for the future forest, why did the Douglas-fir become the dominant tree specie? Again, the presence of the oak may have significantly influenced the outcome in the face of a severe disturbance to the area.

Chart 2: Comparison of Stem Classes per Acre



Seed size may have also played a role in the development of the fir instead of the pine. Douglas-fir seed has a much smaller diameter and may have been more successful in coming in contact or becoming lodged within the loose granite soil. The pine seed, due to its larger size, may have washed off the steeper slopes.

On the east and north facing slopes, the Douglas-fir is the dominating tree species. The fir tolerates more shade than ponderosa pine, so this is to be expected. The pine prefers a higher level of light in order to reproduce. That is the reason pine was typically tallied in a plot on the top of the slopes and not on the lower to mid range portions of the ridges. In addition, the seed of ponderosa pine needs an exposed mineral soil in which to successfully germinate. Again the presence of leaf litter, probably from the oak precludes the ready reproduction of ponderosa pine and encourages the development of Douglas fir.

Finally, the exposure of the slopes and the low watering holding capacity probably did not sustain pine seedlings after germination. Oak seed germinates in the fall, when the weather tends to be wetter and cooler. It sends down a tap root quickly and can exploit favorable growing conditions. Once a moderately dense stand of oak was established, the Douglas-fir could then enter the succession process. The oak would have shaded and protected the fir seedlings from the afternoon heat and dry conditions that would be typical of the site.

There is extensive dwarf mistletoe (Arceuthobium sp.) infection in the Douglas-fir (see Photo 11). Dwarf mistletoe is an obligate parasite. Its survival is totally dependent on its host. If the host is killed, the dwarf mistletoe will die. Dwarf mistletoe rarely kills its host outright, and if it does, it occurs over a long period of time. Normally, the condition of the

host declines to a point where it becomes susceptible to insect attack and is subsequently killed.

Another unique feature of dwarf mistletoe is that it is spread primarily by seed. It has been established that the spread of mistletoe is low, moving anywhere from 10 to15 feet per decade. It can be presumed that the infected stands of Douglas-fir have taken a long time to develop. The primary cause of spread and severity of dwarf mistletoe infections can probably be attributed to the exclusion of wildfire over the last 50 to 100 years.

Dwarf mistletoe can also influence wildfire behavior. The effects of the parasite, such as stunted or dead trees, witch's brooms and resin filled stem cankers, provide more favorable concentrations of readily ignitable fuels.

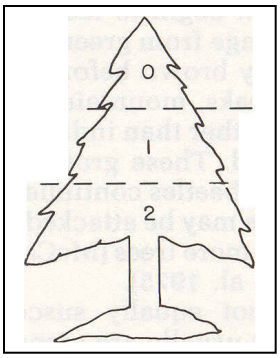
The impact of the dwarf mistletoe on the fir is visually noticeable. The locations where the infection rating is four or higher, individual trees are dying due to the added stress from drought conditions that were pervasive from late 2001 through early 2003. The drought has accelerated the development of Ips beetles which attack and kill weakened and stressed conifers. This condition is the cause of the loss of many small diameter trees on the upper slopes. The larger diameter trees are being attacked by Douglas-fir beetle. These beetles attack stressed and unhealthy trees. The common denominator in this tree loss is the presence of the dwarf mistletoe.

Photo11. Aerial Shoot of Dwarf Mistletoe (Arceuthobium sp.) on Douglas-fir.

During the inventory process, dwarf mistletoe (Arceuthobium sp.) was found at some infection level in or near almost 50% of the plots tallied within the Douglas-fir vegetation type. Infection of dwarf mistletoe in Douglas-fir was not found in the other vegetation zones (see Map 5).

A rating system was developed by the USDA-Forest Service (1977) to quantify the severity of a dwarf mistletoe infection. The 6-class rating system divides the live crown of a tree into thirds and each one-third portion is given a numeric value of 0 – 2. The value assigned to each on-third is then added together to obtain a rating for that tree. Figure 1 provides a visual explanation of this rating system.

Figure 1. 6 –Class Dwarf Mistletoe Rating System



STEP I. Divide live crown into thirds.

STEP 2. Rate each third separately. Each third should be given a rating of 0, I or 2 as described below.

(0) No visible infeclions.

(I) Light infection (1/2 or less of tolal number of branches in the Ihird infecled)'

(2) Heavy infection (more than 1/2 of total number of branches in the third infected),

STEP 3. Finally, add ratings of thirds to obtain rating for total tree.

EXAMPLE: If the upper third has no visible infections, its rating is {O); If the middle third is lightly infected, its rating is (I); If the lower third is heavily infected, its rating is (2). The tree in this example will receive a rating of 0+ 1+ 2 = 3.

The average forest stand rating for the Blodgett Peak Open Space is 1.086. This translates into almost sixty percent of the Douglas-fir within this zone will be infected at some level with dwarf mistletoe.

There appears to be no infestations of mountain pine beetle in the ponderosa pine, even in the larger diameter trees. However, the ponderosa pine in this forest is not immune to troublesome pests. The incidence of mountain pine beetle appears to be rising statewide. Approximately thirty years have passed since the last major epidemic of this insect pest. For the most part, the forest conditions that lead to the major epidemic outbreak in the 70's have not substantially changed.

Fortunately, the growing stock level in this forest appears to be low enough to thwart any sustained outbreak of mountain pine beetle. It is anticipated that there will be areas of isolated attack, mostly limited to the larger diameter trees, twelve inches and greater.

Scrub Oak Zone (SO)

Scrub oak dominates in both the understory and in the percentage of canopy covering the surface. However, as was indicated earlier, there are coniferous trees located within this zone.

On average, there can be up to 36 conifers trees found on a per acre basis. The average diameter of these trees is 8.5 inches. This would be expected as these trees have risen out of the sea of oak to stand as individuals or isolated islands. With the oak surrounding these trees, there is very little regeneration occurring. This would tend to drive the average diameter higher than what might be normally found in a coniferous forest stand.

Ponderosa pine is the more dominant tree specie in this zone. Douglas-fir is readily observed, but only contributes 11% of the zone's tree composition. The fir has a much larger average diameter at 10.0 inches when compared to the pines average diameter of 8.3 inches.

The existence of these trees is due to selective disturbance in the oak or as survivors from a wildfire incident. This may have occurred from mortality to the oak from early or late season frost damage, animals or insect and disease pests. There is a strong possibility some disturbance could have occurred from cattle grazing that created a bare mineral soil for pine regeneration.

In any event, trees do exist within this zone and should be managed appropriately. At the present time, there appears to be no significant infections of dwarf mistletoe in either the pine or the Douglas-fir. The dwarf mistletoe infections that do occur in the ponderosa pine are isolated and do not warrant immediate treatment Neither is there any insect pests warranting control action.

As the number of trees per acre is just over the minimum stocking level, no further discussion of this zone will be considered.

The current health of the scrub oak in the lower southwest corner of the park located in Section 4 may provide an opportunity for a treatment that would not be normally recommended. The oak appears to have been damaged from the combined effects of drought and early season frosts. While the oak has a total height of 10 -12 feet, this damage has reduced the live canopy to 5-6 feet and less in some spots in this area.

Based upon this damage effect, it may be the opportune time to revert this area from a scrub oak zone to an open ponderosa pine stand. In conversation with the Colorado Division of Wildlife, any opportunity to convert closed oak stands to open meadow or ponderosa pine is encouraged. These open spaces provide seasonal forage, particularly for deer and to a lesser extent, bighorn sheep. In addition, these converted areas may lessen grazing pressure by wildlife on adjacent land that has been developed for housing sites.

Ponderosa Pine/Scrub Oak Zone (PP/SO)

This vegetation zone does not exist at the location as shown in the vegetation map in the Blodgett Peak Master Plan. The forested area that is adjacent to Dry Creek and encompasses the area up to the utility access road is best described as the Fir Vegetation Zone. While there is ponderosa pine in this area, Douglas-fir is the dominant tree species.

There are several large ponderosa pine (>10” in diameter) along the north bank of Dry Creek. The presence of these very large trees may have lead to the designation of this zone.

A ponderosa pine/scrub oak zone can be found in the forested area lying just south of the trailhead and just west of the southern water containment pond. Ponderosa pine is the dominant tree species with 75% of the stand composition. There are a total of 194 stems per acre. This area is small; approximately 4 acres in size (see Photo 12). With an average stand diameter of 8.1 inches, the growing stock level (GSL) is 80. However, if the Douglas-fir were totally removed from the stand, the average diameter rises to 8.4 inches and the GSL drops to 60. This would be the optimum level for maintaining this stand in a healthy condition over the long term. The GSL translates into an average of 143 stems per acre.

This stand characterizes the invasion of Douglas-fir into the understory of the ponderosa pine. The small differential also indicates that some fir survived in this stand post fire disturbance.

If the diameter classes are examined, almost 20% of the stems are 12 inches in diameter or larger. This indicates that this forest community is very old (>80 years) and is starting to show signs of indicative of an old growth stand.

There is an understory of scrub oak, but the majority of the oak is suppressed in height, due to the lack of light from the closed conifer canopy. As the bottom of the slope is reached, the oak has a greater height, probably due to increased light levels and water availability.

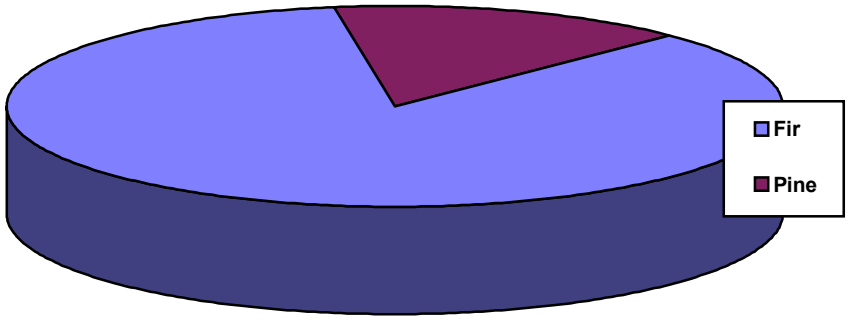
The presence of the oak is sustained by the absence of periodic, low intensity wildfire. Historically, ponderosa pine stands have developed with frequent low intensity ground fires. These fires removed the buildup of pine needles, branches and cones along with any invading shrub or fir species. The absence of periodic fire has contributed to the invasion of Douglas-fir and the large of quantity of shrubs in the current understory of this stand.

This particular forest stand provides an excellent opportunity to serve as a living laboratory to educate the public about the role fire plays in western forests. It is suggested here that this ponderosa pine be restored with the active application of fire on a periodic basis.

Douglas-fir Zone (Fir)

As this zone indicates, the dominant conifer is Douglas-fir and it composes 85% of the zone total (see Chart 3). Within this total lies approximately 8% white fir. For inventory purposes, both of these tree species are treated the same.

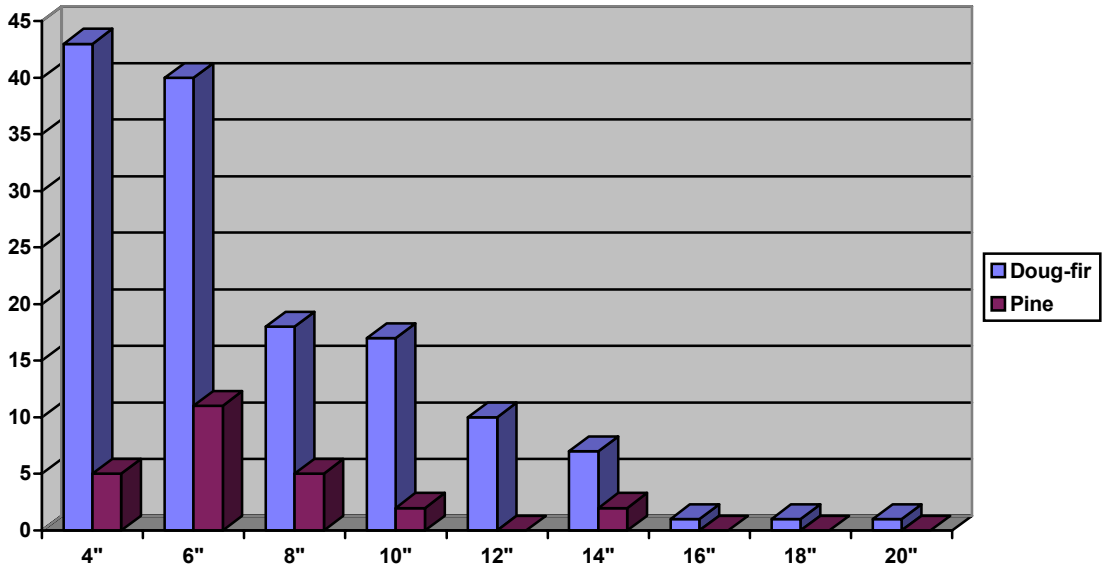
Chart 3: Species Composition of the Douglas-fir zone



Douglas-fir and the ponderosa pine have the virtually the same diameter average at 7.9 and 7.4 inches. Due to the large number of Douglas-fir per acre, the zone average diameter is 7.8 inches. Again these figures illustrate the relative uniformity of the conifers within this zone and the park as a whole (see Chart 4).

Based upon an average basal area of 46, the Douglas-fir has a growing stock level in the range of 50. At this level, there should be, on average, 120 trees per acre. So the Douglas-fir in this zone could be considered slightly over stocked. This would necessitate some individual tree removal to balance the number of trees per acre with this growing stock level.

Chart 4. Comparison of Stem Classes per Acre – Fir Zone Only



However, if the goal is to maintain the status quo of a diverse stand of conifers in this zone, the target growing stock level should be raised to 60 and this would result in the current stand condition being within this growing stock level with no further treatment or removal of trees being required. Based upon the overall health of the forest, it is assumed here that the diversity of coniferous species is the preferred goal, instead of a monoculture of Douglas-fir.

The main forest health issue in this zone is the dwarf mistletoe infection in the Douglas-fir (see Map 5). While the view of this infestation appeared somewhat benign in the overall picture, the dwarf mistletoe rating in infected stands within this zone climbs to 2.63, almost 1.5 points higher than the forest average. The higher rating also predicts that in excess of 80% of the fir is infected with dwarf mistletoe. This is significant as this rating directly impacts the future treatments.

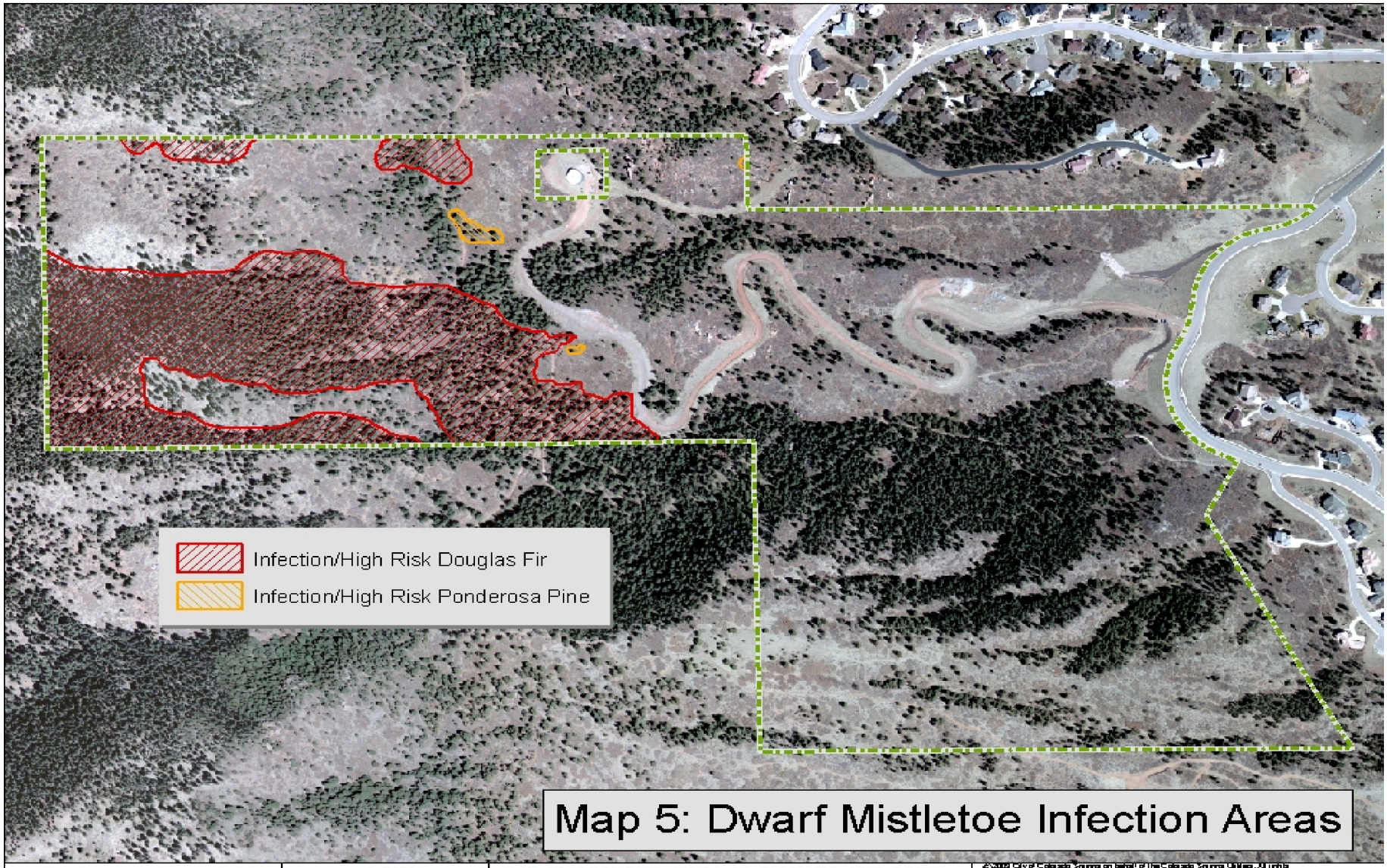
First there are the obvious health impacts to individual trees and subsequent increased risk of mortality from insect and disease attack. This condition coupled with the effects of the current drought, will lead to continued loss of firs and their unsightly visual impact on the landscape as a whole.

If the Douglas-fir in the zone is thinned with the goal to decrease the quantity of the fir and increase the number of other conifers, then this type of treatment should be limited to stands where the average dwarf mistletoe rating is 3.0 or less. While the current average meets this recommendation, it is also very close to exceeding the recommendation. So when a specific acreage is scheduled for treatment, a more intensive level of inventory will be required. This may add an additional expense to any treatment in this zone.

In a normal situation, two to three entries could be utilized to control dwarf mistletoe while still maintaining a tall canopy for visual and aesthetic values. However due to the difficulty and expense in dealing with the steep slopes coupled with the uncertainty of funding for treatments, a one time entry may be the initial best management practice.

A one-time entry into the Douglas-fir requires the performance of all treatment activities at the same time. In other words, this would include the removal of all dwarf mistletoe infected trees, no matter what the size and the thinning of non-infected firs. This would also include the removal of trees that are damaged from environmental conditions and those having poor form and vigor. In the situation that exists within the open space, this will result in a high negative visual impact and potentially create a soil erosion hazard.

The use of a one time entry poses social and silvicultural issues that would not be associated with a multiple entry for dwarf mistletoe control. In addition, the high potential for severe soil erosion would necessitate post-entry treatments that may also add costs not found if natural regeneration could be relied upon. In any event, the treatment schedule will pose a conflict with the vision of the master plan as it does call for restoration of natural communities yet still preserving the natural resources of the Blodgett Open Space.



There are other potential pests that could have a major impact on the Douglas-fir zone. The first is Douglas-fir tussock moth. This insect has been found in the metro area and periodic outbreaks have severely defoliated individual trees. In 1993, this insect severely damaged and destroyed fir on approximately 7,000 acres in southwest Douglas County. So while this insect has not been a major pest within the open space, it has the potential to cause a significant amount of damage in a very brief time.

Another insect pest is the western spruce budworm. While spruce can be defoliated by the larvae of this moth, its preferred food source is white fir and Douglas-fir. Again, this insect has been responsible for limited damage in the metro area. In the early 1980's, a severe population explosion of budworm defoliated thousands of acres in western Teller County and Park County.

Regular inspections that focus on these insect pests should be performed annually within the Blodgett Peak open Space.

The Dry Creek Unit

This unit is listed as a distinct subset of the vegetation zones and it crosses all of the other zones listed in the master plan. The boundary of this unit is the entire length of Dry Creek as it passes through the property. The minimum width of this zone is fifty feet on either side of the creek channel.

The width of the boundary beyond the fifty foot minimum is suggested where the creek bottom lies adjacent to steep slopes and highly erodible soils such as those encountered in the western one-third of the park. The actual width will be dictated by the treatment proposed in these locations.

The banks of Dry Creek appear to be stable and are not actively eroding. There is evidence of seasonal flooding and subsequent scouring of the creek bed.

There are a number of wetland species present. Of most interest is the presence of colonies of native Bee-Balm (Monarda sp.). These colonies are large enough to be self sustaining and add a unique recreational component to the unit.

The primary concern in this unit is the infestation of Canada thistle. Appendix 3 supplies a description of this noxious weed and the steps required to contain its spread and eradication methods.

An opportunity exists in this unit to improve and/or create small pools of water within the Dry Creek channel for use by wildlife. These pools should be constructed along the entire length of the creek system if possible. The intent here is to increase the quality of the overall wildlife habitat use of the open space.

Wildfire Hazard – All Zones

The wildfire hazard in the Blodgett Open Space is fairly uniform across all the vegetation zones found in the park. Based upon the Wildfire Hazard Area Map (WHAM) produced by the Colorado State Forest in 1974, the park is rated as severe for brush and trees (see Map 6). These ratings have not improved with the passage of time.

In 1999, the Colorado State Forest Service (CSFS) undertook a review of the work performed for WHAM and added information on population, number of structures, fire ignition history and the vegetative fuel type. From this review over 6 million acres of forest land were rated as having a high risk for a large scale fire. These acres of forest have been labeled as being in the "Red Zone" (see Map 7). The Blodgett Peak Open Space falls into this classification.

While forest management treatments will reduce the potential for wildfire within the open space, it should not be assumed that these treatments will be sufficient in abating the effects of any wildfire that should originate inside or outside of the open space boundary.

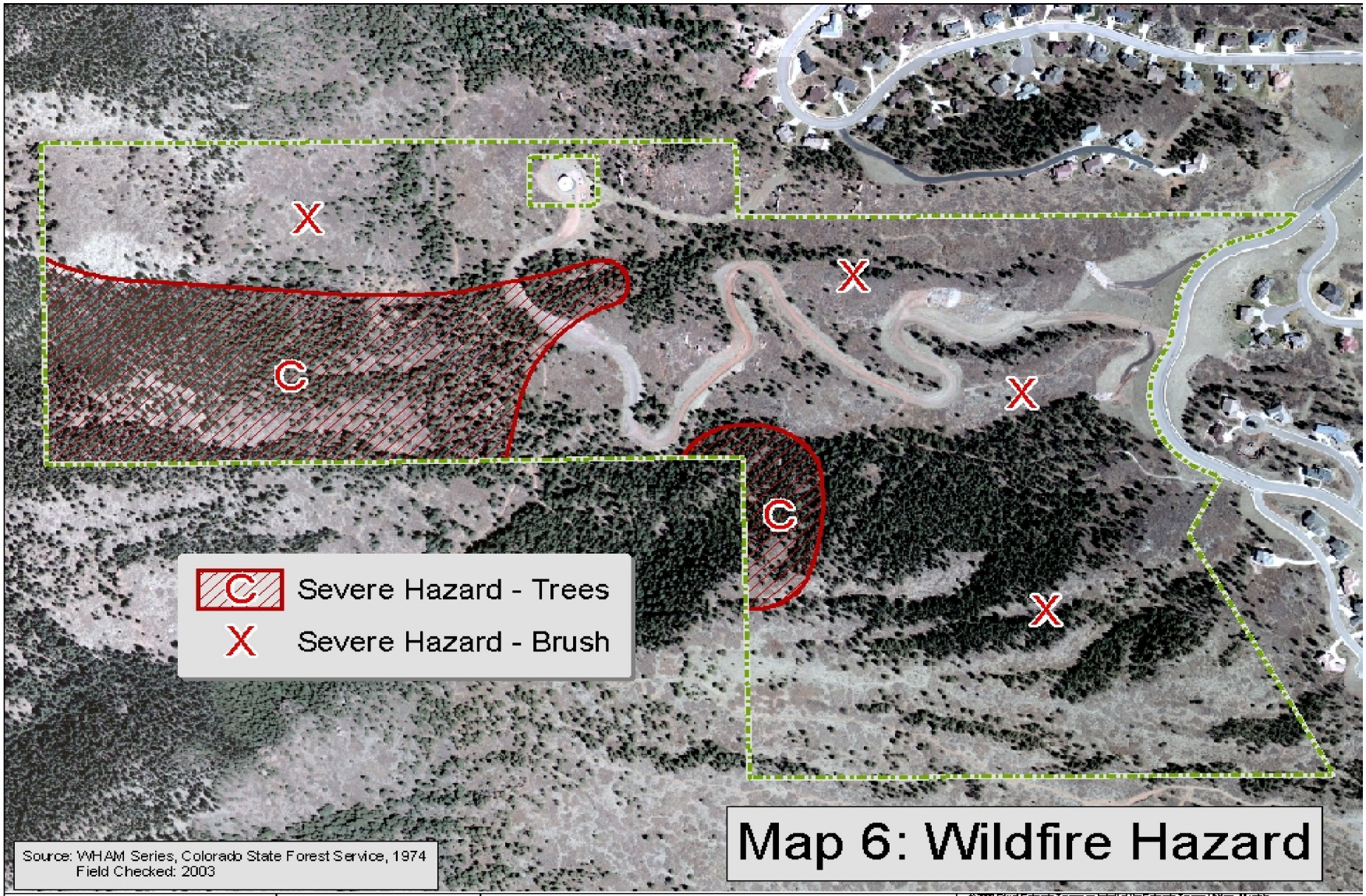
The major factor affecting the spread of a wildfire is the steep slopes that are part of the geographic features of the open space. The steep slopes provide a positive benefit when viewed in the landscape perspective and a visual asset of the open space. But this same feature, when evaluated as part of the wildfire hazard, is a negative benefit that cannot be modified in any manner.

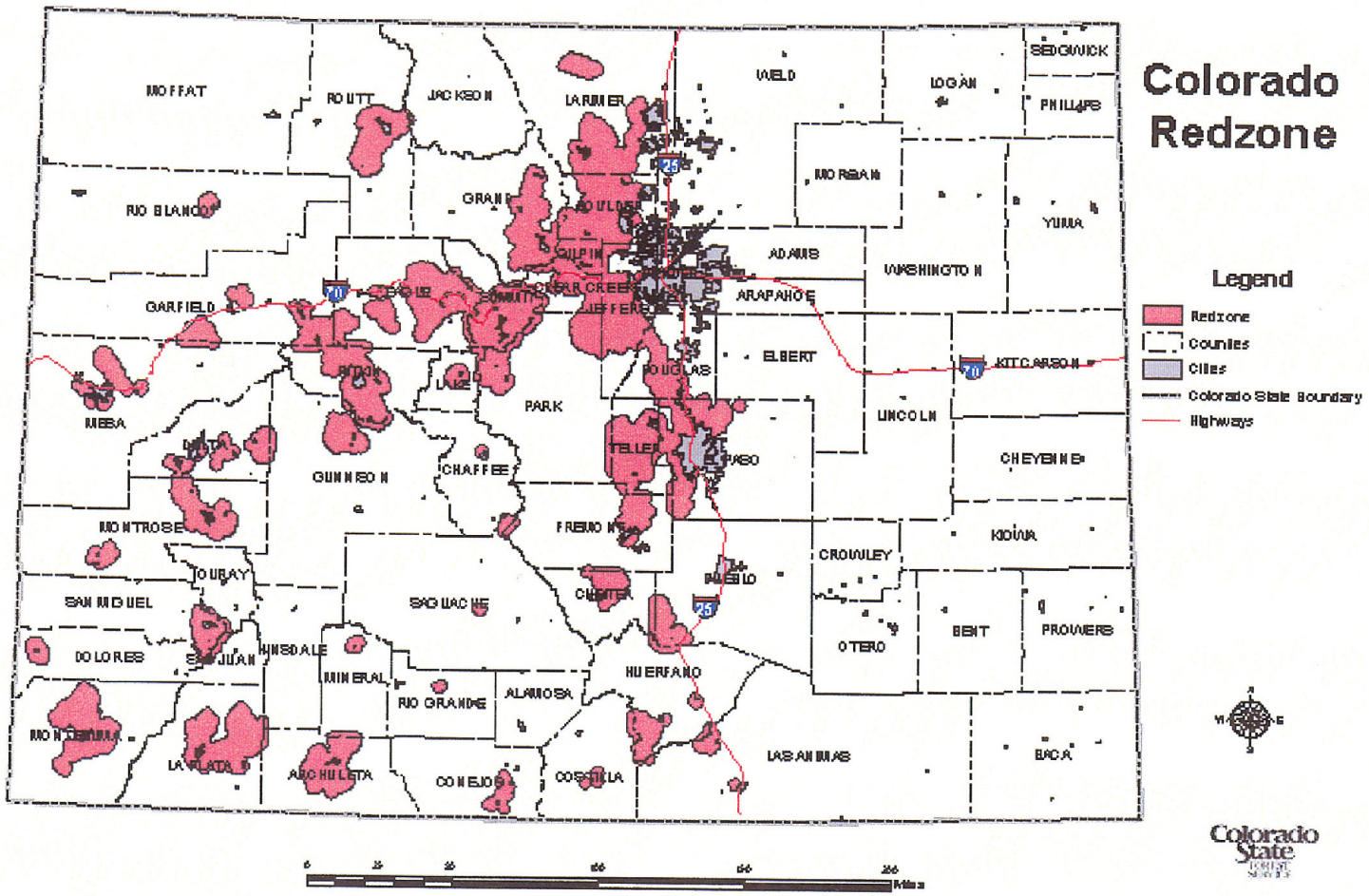
Secondly, catastrophic or stand replacement wildfires are part of the ecology of the area. No matter what mitigation steps are taken, this risk will always exist and manifest itself over time.

The Blodgett Peak Open Space represents a very small fraction of the acreage in western El Paso and eastern Teller County that is classified as being in the 'Red Zone'. As was observed during the Hayman Fire and the Schoonover Fire, extreme fire conditions may overwhelm treated acres, barely providing a barrier to the fire spread. So the open space may suffer the effects of a catastrophic wildfire in spite of the best wildfire mitigation activities.

Wildfire Behavior

This rating takes into account the role of the three major components that affect wildfire behavior; fuels, topography and weather. These three components will be examined in relation to the Blodgett Peak Open Space.




Colorado
Redzone
Legend
Redzone
Counties
Cities
Colorado State Boundary
Highways
MOFFAT
ROUTT
JACKSON
LARIMER
WELD
LOGAN
SEDGWICK
PHILLIPS
MORGAN
YUMA
RIO BLANCO
GRAND
BOULDER
GILPIN
ADAMS
WASHINGTON
GARFIELD
EAGLE
SUMMIT
CLEAR CREEK
JEFFERSON
ARAPAHOE
ELBERT
KIT CARSON
MESA
PARK
DOUGLAS
LINCOLN
CHEYENNE
DELTA
GUNNISON
CHAFFEE
TELLER
EL PASO
MONTROSE
FREMONT
KIOWA
CROWLEY
OURAY
PUEBLO
SAN MIGUEL
SAGUACHE
CUSTER
OTERO
BENT
PROWERS
DOLORES
SAN JUAN
HINSDALE
MINERAL
RIO GRANDE
ALAMOSA
HUERFANO
MONTEZUMA
LA PLATA
ARCHULETA
CONEJOS
COSTILLA
LAS ANIMAS
BACA
Miles

Fuels

The area was field checked and the results of the WHAM were confirmed based upon the observed fuel models on the property. The USDA-Forest Service developed fuel models for use in determining fire behavior in 1972. From their initial development and subsequent modification, thirteen fuel models are utilized in predicting fire behavior. The Blodgett Open Space exhibits the characteristics of two of these fuel models.

The criteria for choosing a fuel model reflects that a wildfire will burn in that fuel type which best supports that fire. There may be more than one fuel model represented on any given area of land. Photo 12 shows how this multiple fuel model exists. There are enough trees per acre to consider this a ponderosa pine forest. However, the scrub oak will be the primary fuel that will influence the behavior and spread of a wildfire. The pine will not significantly influence a wildfire. In addition, current and expected weather conditions will influence the condition of these fuels.

Photo 12. An example of the primary fuel type (scrub oak) with a pine overstory. The ponderosa pine will contribute very little to the behavior of a wildfire.

The two different types of fuel found in the open space are brush and trees. These fuel types correspond most closely to USDA-FS Fire Behavior Fuel Model 6 and Fuel Model 8. A copy of the descriptors of these fuel models is enclosed as Appendix 4.

The first and most serious is known as Fuel Model 6. This model best describes the scrub oak (SO) and the ponderosa pine/scrub oak (PP/SO) vegetation zones (see Appendix 4). “Fires carry through the shrub layer where the foliage is more flammable than Fuel Model 5 (fire is generally carried in surface fuels…), but this requires moderate winds. An example of this fuel model on the open space is provided in Photo 13. Fires within this fuel type tend to be very intense and fast spreading, particularly where there are moderate wind speeds and rolling or moderate slopes. This fuel model played a significant role in the tragic 1994 Storm King Wildfire incident in Glenwood Springs, CO.

Photo 13. This represents a view of the Gambel oak above the water tank. Notice the isolated conifers and the lack of open grassland spaces.

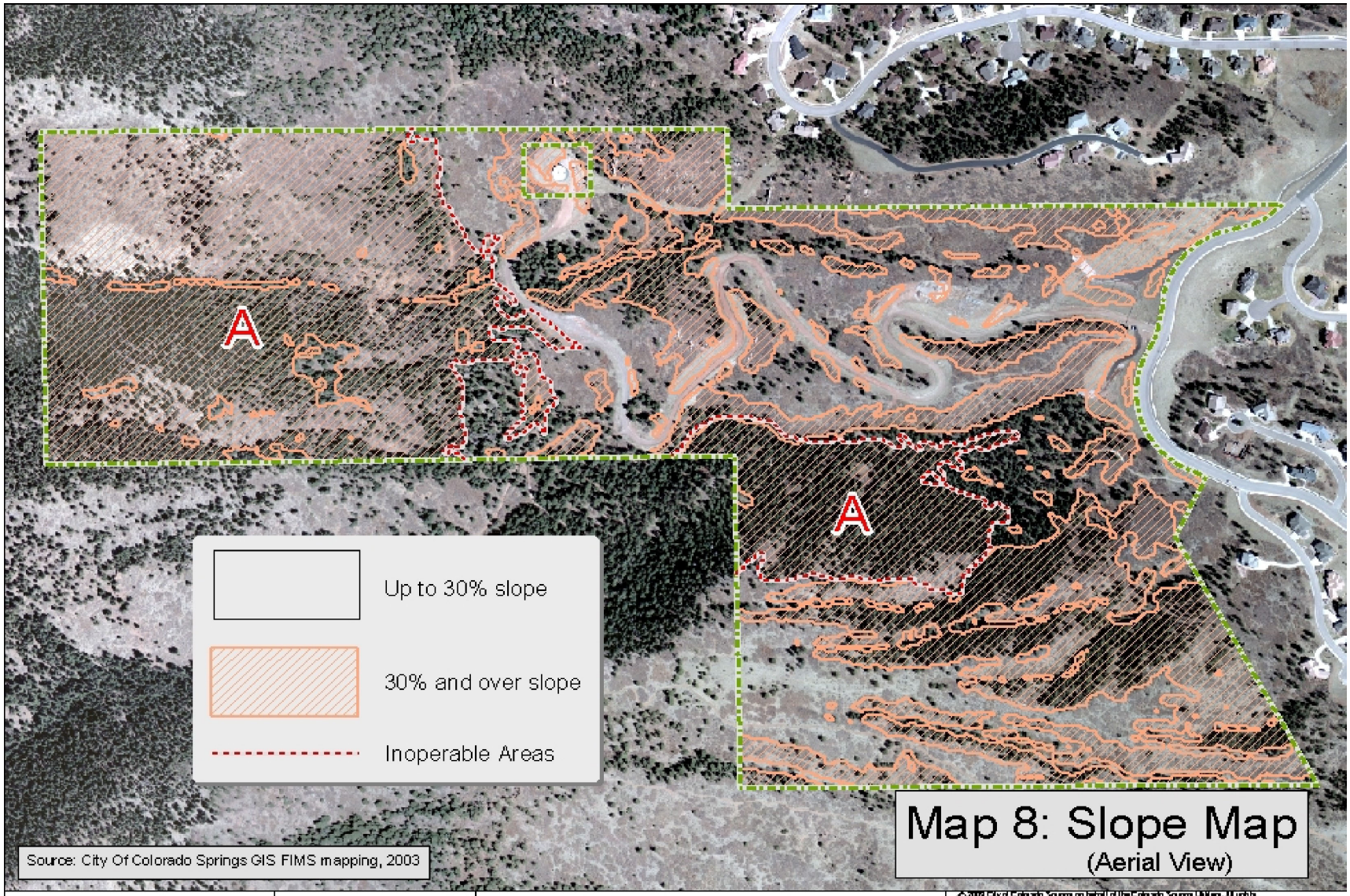
Fuel Model 8 best describes the fuel loads on the north-northeast-facing slopes, which is closed stands of conifers (Douglas-fir Zone) with low levels of dead-down woody material. “Slow burning ground fires with low flame lengths are generally the case.” Only under severe weather conditions involving high temperatures, low humidity’s and high winds do the fuels pose fire hazards.” Photo 14 provides a typical view of the understory in the fir vegetation zone on Blodgett. Again, the major factor influencing fire spread will be the steep slopes that are present.

Photo 14. Typical view of the understory conditions within the Fir Zone. Note that understory is composed of a thick duff or needle layer with occasional fuel in excess of three inches in diameter.

Topography

The topography of the site is one of the main factors that will influence a fire spread. Aspect or compass direction can influence the effects of diurnal winds, as they move upslope during the daylight hours and down slope during the evening and early morning hours. The aspect also influences the fuel type that is present. The amount of fuel preheating is an additional factor of the aspect.

In this instance, the main factor that contributes to the severe risk is the presence of slopes in excess of thirty percent. As the percent of slope increases, the rate of fire spread by convection increases. Wildfires burn faster moving uphill (see Figure 2). Slopes in excess of 25% are considered extreme slopes regarding their effect on wildfire behavior. This topographical feature is found throughout the open space and will create conditions conducive to the rapid spread of a wildfire, particularly one that originates at the bottom of the slopes. Map 8 & Map 9 supply a vegetation and geographic view of these slope locations. Unfortunately there is no management practice that is available to reduce the influence of the steep slopes.



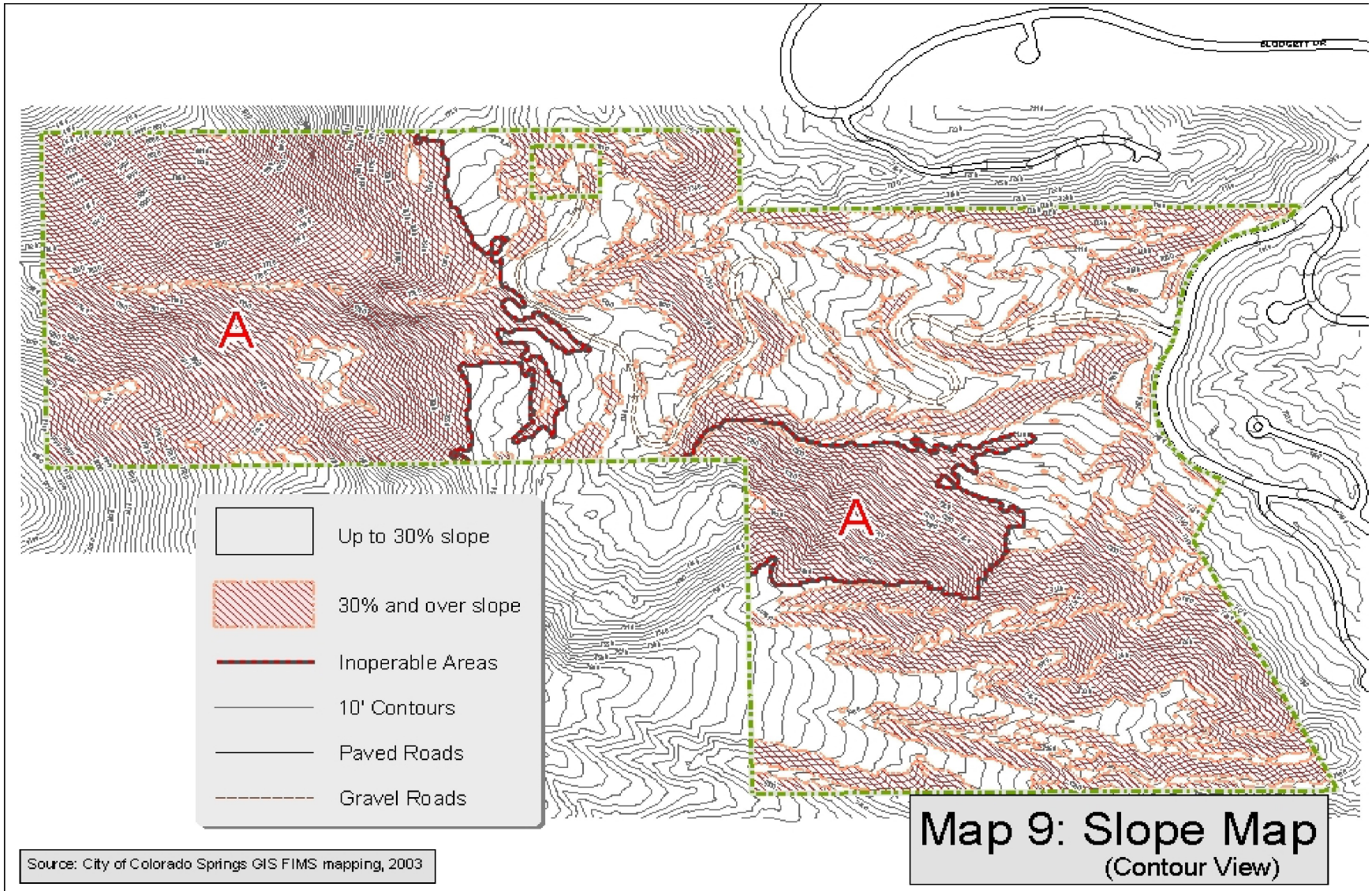
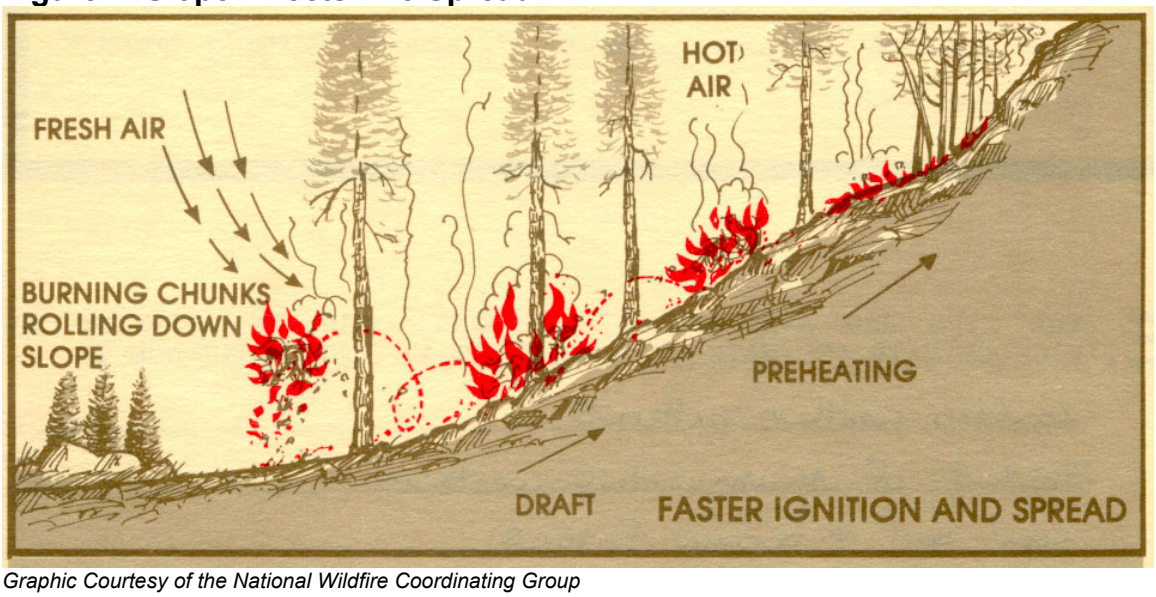


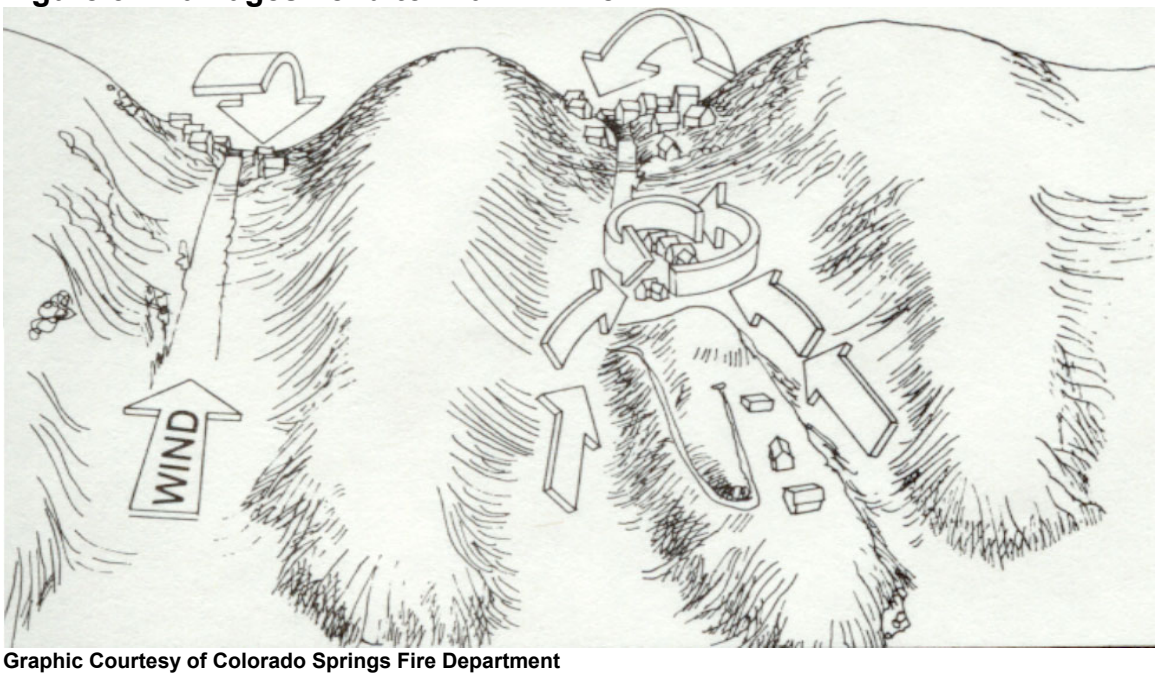
Figure 2. Slope Affects Fire Spread



Graphic Courtesy of the National Wildfire Coordinating Group

Figure 3 depicts the effect the drainages and/or box canyons have on a fire. These topography features tend to funnel a wildfire uphill within a narrow profile and the preheating effect tends to ignite the side slopes of the drainage. This condition is found in the Dry Creek drainage, particularly as it flows through the western third of the open space.

Figure 3. Drainages Tend to Draw in Fire



Graphic Courtesy of Colorado Springs Fire Department

Weather

Weather is the most variable of all the factors. The accumulative effects of weather over time can influence vegetation curing and fuel moisture content.

Grasses, for example, are described as being one-hour time lag fuels. Time lag is a measure of the rate at which a given dead fuel gains or loses moisture. Hence grasses tend to be influenced by the weather conditions on an hourly basis. Wood fuels that are three inches in diameter or larger are considered to be 1,000-hour time lag fuels. So this type of fuel requires a long period of dry or wet weather in order to affect its combustibility.

Winds can influence the direction and rate of spread of a wildfire. Short spotting of the fire by embers transported by winds ahead of the main fire is a concern.

In the event of extreme fire behavior, as was witnessed on the Hayman Fire this past summer, the fire itself will exercise some degree of influence on its environment.

So while the weather may contribute greatly to a wildfire event, the weather is immune to the influences of any wildfire mitigation activities.

A benefit derived from the disturbed corridor (DC) zone is that it provides a line of defense to the spread of wildfire in the northern half of the property. Besides the exposed surface of the road itself, the absence of trees and brush will help to reduce the intensity of a fire as it approaches the utility access road. This barrier may slow the spread of wildfire sufficiently enough to allow control by local suppression forces

In addition to the threat of wildfire within the open space area, there is the risk of loss to private property lying adjacent to the park. Structures built on the top of slopes adjoining the park in the northeast and within the highly flammable fuel model 6 to the southeast may be at risk of complete loss if a worst case scenario were to occur.

Predicted Fire Behavior

Based upon fire behavior modeling a wildfire will spread rapidly and quickly uphill towards the west boundary with the USDA – FS Pikes Peak Ranger District. Using the USDA – Forest Service Fire Behavior Fuel Model, the following predictions can be made based upon an 80-degree day with a relative humidity of 18% and little cloud cover at 1:00 p.m. in July. Winds are blowing at 12 M.P.H. from the south/southeast and it has been three weeks since a significant moisture event.

The drainage used in this example is Dry Creek and the ignition originates just northwest of the road spoil pile.

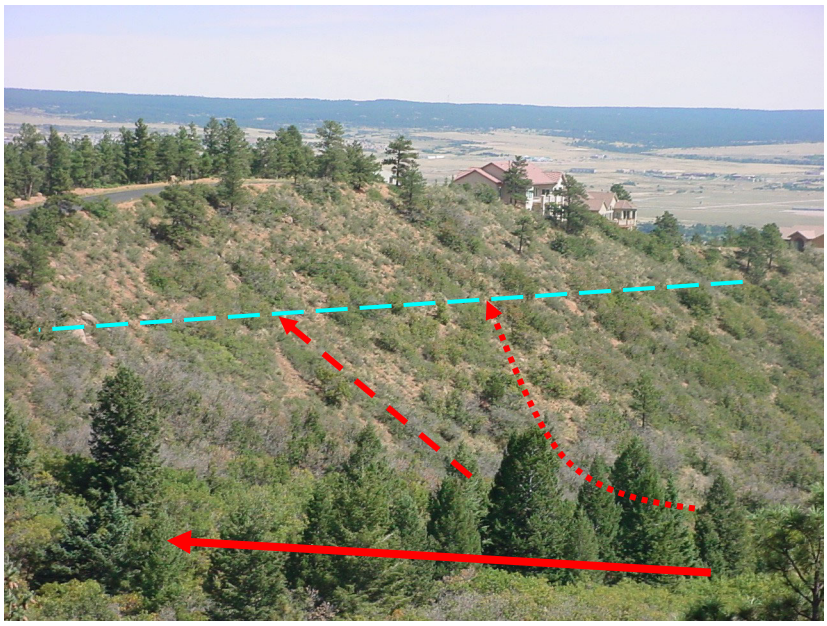


Photo 15.

The photograph above (Photo 15) provides an example of the expected inital fire movement. The light blue dashed line is the approximate property boundary location. The solid red arrow indicates the direction of the main fire front. The dashed red arrow show secondary side slope movement up towards the street called Angelstone Point. The dotted red arrow shows tertiary fire movement up a small drainage also towards Angelstone Point.

It should be noted here that as the fire moves toward private land along Angelstone Point, the fuel that will carry a wildfire changes from a shrub type to a grass type. This change in fuel type should allow the road to act as a fuel break and control line. Further fire spread in this direction should stop or be readily controlled by initial response forces.

The fire will spread quickly, at a rate in excess of 4000 feet per hour, or 67 feet per minute. Flame lengths will range from 8 to 9 feet. The probability of fuels igniting in advance of the fire front is 100%. In the fifteen minutes that it may take for the fire to be noticed, reported to the fire department's dispatch office and for the arrival of the initial

attack force, the fire could have traveled over 1,000 feet and be approximately 14 acres in size with a total perimeter distance approaching 3,036 feet.

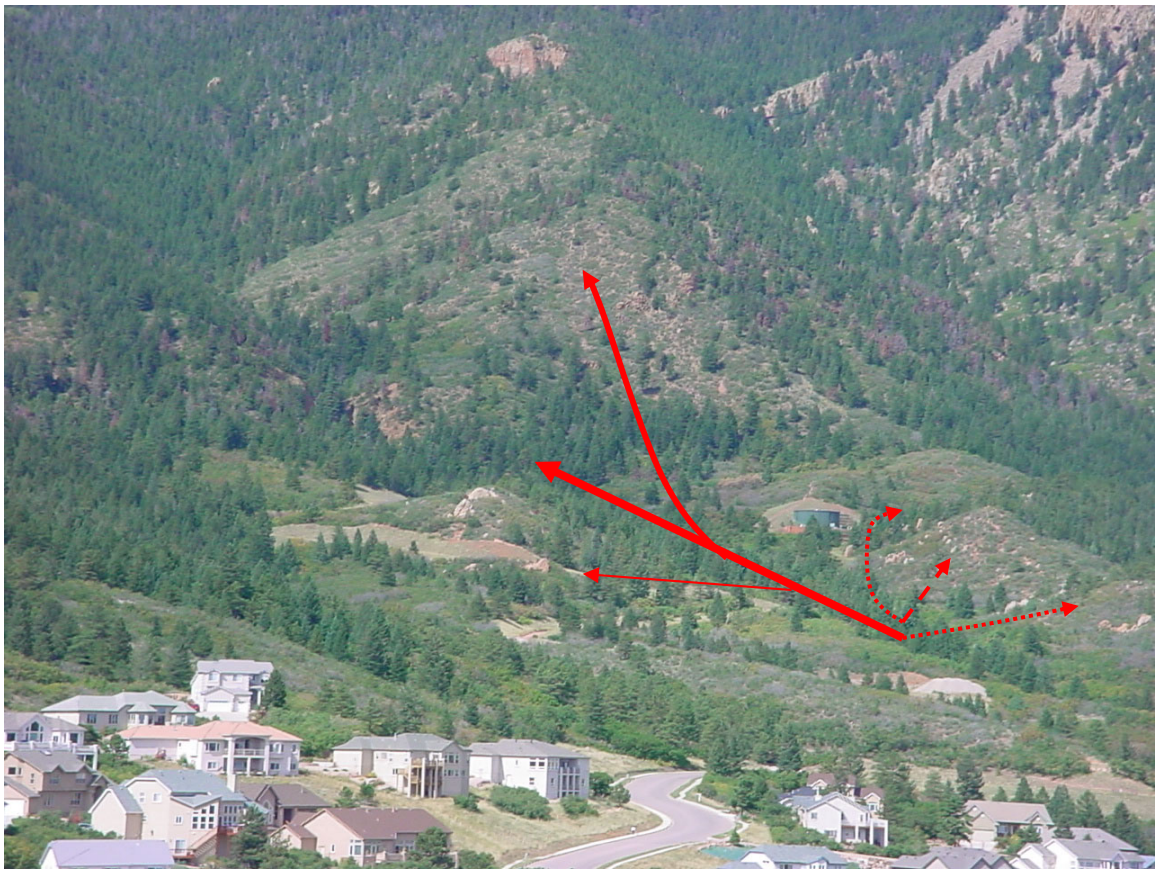
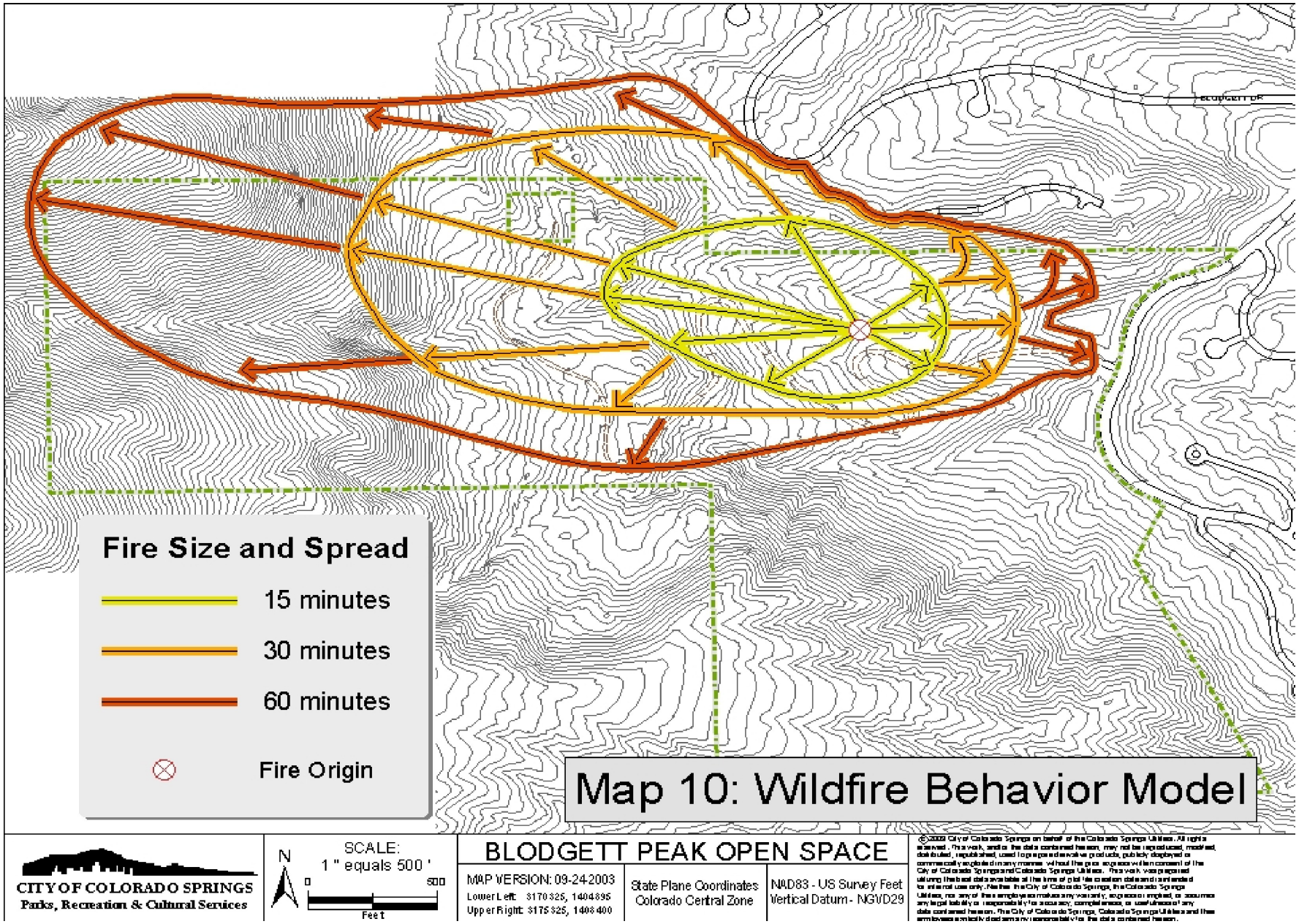


Photo 16.

As the fire moves up the Dry Creek drainage to the west, the fire will be funneled uphill onto the south-facing slope. Here, the fire will accelerate its rate of spread to 4,383 feet per hour or 73 feet per minute. Again, in the time it takes to begin initial attack and request additional fire suppression resources, the fire may have moved uphill another 1,095 feet and be approximately 124 acres in size with a total perimeter 12,738 feet.

The photo above (Photo 16) depicts a potential scenario of this wildfire spread. The solid red lines show the main run of the fire. The dotted line shows another run up a slope that enters private property. The change in fuel model as the fire moves uphill changes to grass. The dashed lines show the direction of low intensity runs of the fire. It is projected that the utility access road and the spoil pile will limit spread to the south. See Map 8 for a projected view of a wildfire over the first sixty minutes.

It is predicted that local suppression forces will not be able to contain the initial fire outbreak with mobile engines and hand constructed control lines within four hours of initial attack. It is estimated that it will take two line crews in excess of 18 hours to construct, burnout and hold the fire perimeter.



It should be noted that these predictions are based upon normal weather conditions prevailing over the course of a year. Weather conditions that were exhibited from the fall of 2001 through the present date are outside of normal conditions resulting in the catastrophic losses experienced throughout the western United States this past fire season.

If such conditions are present on or in the vicinity of the open space, any wildfire event can be predicted to be more severe and resistant to initial control efforts.

The normal diurnal winds will accelerate the wildfire incident. If the normal diurnal wind patterns are present, a wildfire will move quickly uphill from the east and more slowly from the west. The drainages will draw the fire upslope by increasing wind velocity. This convective heat current will accelerate the pre-heating of available fuel upslope of the fire. It is expected that the fire will move upslope rapidly with high but short-lived heat intensity.

Finally, it should not be assumed that the main periods of fire danger would be in the summer months. As past history has shown, out of season fire events are much more common than might be expected by the public. The Berry Fire, near the USDA-FS Work Center in Monument, CO ignited in the month of April.

Inoperable Acres – All Zones

Approximately 107 acres of the open space are situated on slopes exceeding 30% (see Map 9). This represents over 63% of the total area of the open space. However, some locations where steep slopes are present exist over short lengths and pose only minor limits on management activities.

Of the total acreage having steep slopes, 62 acres are considered to be inoperable. This is due to a combination of slopes in excess of thirty per cent, rock cliffs, exposed granite fields and surface bedrock. The severe slopes and rock barriers make these inaccessible to silvicultural activities based on the locally available contractor force. Additionally, the lack of harvestable volume within these areas makes them financially more expensive to treat at the current time.

Prescription for the Vegetative Zones

Disturbed Corridor Zone

As was discussed earlier, the control and subsequent eradication of the noxious weeds within this zone is the highest priority for management treatment within the open space.

Treatment should follow the guidelines put forth by the CSU Extension Service.
In the locations where musk thistle is found above the impoundment areas, the use of volunteers to collect the seed heads from these plants is recommended. This will allow the general public to gain ownership in the management of the park. This activity will also provide an opportunity to educate the public of the threats posed by these noxious weeds to the natural resources of the park.

In addition, any mechanized equipment that is used for the control of noxious weeds or in seeding treatments should be thoroughly cleaned to prevent the movement of weed seed to other locations within or into the open space. If straw mulches are prescribed to assist in the establishment of the seeded areas, the use of certified weed-free mulch should be required.

The road spoil dumps should be contoured so that they blend into the natural topography and vegetated with native perennial grasses. Based upon the current plant communities found on these spoil piles it will be necessary to either improve the spoil with an organic amendment or to cap the spoil with a layer of topsoil at least six inches thick.

A custom seed mix and application rate can be developed in consultation with the National Resource Conservation Service (NRCS).

Scrub Oak Zone (SO)

The south and west-facing slopes of this unit should be restored to the ponderosa pine forest type where the slopes and soils will permit a reasonable expectation of success. The best opportunity for this restoration effort is located along the lower southwest boundary of the property (see Map 4). As was described earlier, the oak in this area has been damaged and may not tolerate any further disturbance, making it a good candidate for permanent removal.
In addition, the absence of steep slopes in this area will allow the use of conventional treatments.

A jeep trail provides potential access to this location. While this access crosses both private and federally owned lands, the potential reduction in wildfire risk to both landowners may be sufficient to obtain their cooperation. The existing jeep trail would only require minor improvements to be utilized.

The oak should be physically cut and forced to sprout from the roots and cut stumps. Based upon the current health of the oak, the maximum sprouting potential may not be realized when compared to a healthier stand of oak. If after cutting the oak, the sprouting potential is found to be greater than expected, it may be reduced further through the use of fire, physical or chemical treatments.

These treated areas should be limited to two to three acres in size to facilitate follow-up treatments if required. This results in a minimum treatment period of four years. This restoration activity should no be initiated until the control of noxious weeds has been started.

Cut the oak as close to the ground as possible and pile the resulting woody debris. These piles would be burned during the winter months when there is a light snow cover on the ground. The disposal of the woody debris will reduce the wildfire risk in the most efficient manner.

In locations where the slope precludes the disposal of slash by burning, the area should still be treated by cutting the oaks and lopping and scattering the debris to reduce the fire hazard. While this type of activity may be unsightly over the short term, it will enhance the seedbed for future natural regeneration. Organic material will provide protection from solar radiation and temper dry soil conditions so as to allow natural regeneration.

In regard to the natural restoration of the ponderosa pine type, a lack of surface disturbances in this zone provides little bare mineral soil for seed produced by the existing pine to germinate. The removal of the oak canopy should create soil conditions to ameliorate this condition. But this does not totally address all of the challenges involved in developing a natural restoration effort.

With a small number of ponderosa pine per acre available to produce viable seed, there is a relatively low seed bank to draw from. In addition, ponderosa pine produces a major crop of seed every ten to fifteen years. So relying on natural regeneration may not be sufficient to achieve the desired restoration result.

Therefore, hand planting may be necessary. This should be initiated if sufficient regeneration has not been achieved within three years after the treatment of the oak. A target for natural regeneration should be in the range of 300 seedlings per acre.

A target of 200 stems per acre at age twenty should be the goal for artificial regeneration efforts. Assuming an initial seedling loss of 50% over the first three years, 350 seedlings should be planted per acre. If survival techniques are used to lower this projected mortality rate, a smaller number of seedlings may be necessary to achieve the desired results.

Where isolated pockets of conifers exist, these areas should be thinned and the least vigorous trees removed. The intent here is to increase the overall health of the remaining conifers and improve the seed production potential for natural regeneration.

The recommendation to remove the oak around individual or islands of conifers to encourage expansion is a low priority activity. Due to higher priority treatments in the other zones, no activity is recommended at this time.

Wildfire Mitigation

Where this vegetation zone abuts private land and poses a threat to structures, the oak should be treated to reduce this threat. This would involve the removal of oak islands. Based upon worst case scenario fire behavior modeling, a minimum distance of 100 feet along these boundaries should be considered for this type of treatment.

The form classes of the oak within this strip should be considered when selecting which oak to remove. Within close proximity of the open space boundary, clumps that are smaller in height should be retained and taller clumps should be removed. As the 100 foot limit is approached, the clumps or islands of oak may be allowed to become larger in size and taller in height. The intent is to break up the continuous line of fuel as the boundary is approached. This mitigation treatment should help to reduce the risk of a fire spreading rapidly to private property while retaining the privacy that the open space provides.

There should be a minimum separation of sixteen feet between clumps or islands of oak. The separation distance should contain open or grass covered ground and should be maintained in this condition indefinitely where possible.

If sufficient funding can be obtained, the clumps or islands of oak that are retained in the 100 foot treatment strip should be thinned. This thinning treatment should remove the least vigorous and dead stems within the clump or island. The removal of an excessive number of live stems may result in sprouting and negate the benefits gained from the thinning.

No other wildfire mitigation treatments are recommended for this vegetation zone.

Ponderosa Pine/Scrub Oak Unit (PP/SO)

In this unit, the restoration of ponderosa pine should be the management goal. However due to the higher number of stems per acre, a variation on the treatment described in the Scrub Oak Zone is suggested.

In this zone, the oak should be removed from around existing pines or islands of pines at a width no greater than height of the residual trees. This will reduce the visual impact of the treatment, yet still provide conditions sufficient for natural regeneration.

At the same time that oak removal occurs, the residual ponderosa pine should be evaluated for overall health and growth form. Pines that are suppressed due to the canopy of a neighboring dominant tree should be removed. Any individual trees found to be infected with dwarf mistletoe should be removed where the infection rating exceeds 2. All other trees should have infected limbs pruned off. Ponderosa pine that are bent over from snow loading or exhibit poor vigor or growth form characteristics should also be removed at this time. All Douglas-fir trees with a diameter of less than twelve inches should also be removed.

Initial attempts at natural regeneration of the ponderosa pine should be timed in accordance with potential cone production. Ponderosa pine produces a minimal seed crop approximately every two years and heavy cone crops every 8 -10 years. As it requires two growing seasons for the seed to mature within the cones, there should be sufficient time to plan removal cutting so as to maximize suitable seedbeds. The seed typically falls from the cones in very late summer to early fall.

The improvement of the overall health and growth forms of the pine within this zone should also benefit its resistance to loss from wildfire. In order to reduce the encroachment of oak over time, a prescribed fire regime should be established. This would result in a planned burning of this unit every five to twenty years.

The role of periodic light fire in the ponderosa pine ecosystem has been recognized for some time. Fire may be the best tool available in preserving and restoring the majority of the vegetation zones within the park. It is recommended here that the PP/SO unit be the first area treated in this manner. Once a successful application of the fire regime has been achieved in this location this tool could be expanded to other locations within the open space, such as the restoration area in the scrub oak zone. It should be noted here that a successful introduction of a fire regime would be the application of fire at this location a minimum of three times.

Douglas-fir Zone (Fir)

The major factor affecting the Douglas-fir zone is the presence of dwarf mistletoe in the Douglas-fir. This forest pest condition is the **second overall priority** for management treatment. The impact of the dwarf mistletoe on the fir is visually noticeable. Trees exhibiting a dark rust color succumbed to the effects of the drought and the parasitic behavior of the dwarf mistletoe. The presence of red colored hills in the coniferous forest has provided an opportunity to initiate a control strategy for dwarf mistletoe.

It is assumed here that a ‘do nothing’ strategy is not desirable. While the most visible infections lie on the upper slopes of the western portion of the open space where control is difficult, dwarf mistletoe can also be found in the lower portion of the slopes that are accessible to mechanical treatment.

It is recommended here that where dwarf mistletoe can be found at the lower elevations, all infected overstory trees should be removed. These treatment locations should be limited to five acres in size, with isolated pockets of infection being treated first.

Reentry into these treated areas should occur every three to five years. The intent is to either prune infected limbs or remove trees from the remnant understory that have developed outward symptoms of parasitism by dwarf mistletoe. In addition the trees that border the treatment area need to evaluated for mistletoe infection and the appropriate treatment applied.
At the higher elevations where the slopes exceed 30%, conventional practices are difficult. In most instances, all infected trees in both the understory and overstory will need to be removed. In this instance, the tree trunks and limbs will need to be left on

site. This will contribute to a temporary risk of severe wildfire behavior if an ignition in the area occurs.

The timing of the treatment of the dwarf mistletoe may be influenced by activities that are being planned on the local Pikes Peak District of the Pike National Forest. At the present time, the Trout –West Hazardous Fuels Reduction Project, located in Teller County is concluding its environmental review and may be implemented in the next 2-3 years. This project may bring treatment technologies to the area that cannot be found at the present time.

One of these technologies worth noting is the use of helicopters to remove merchantable (>6" in diameter) and unmerchantable (<6" in diameter) conifers. These trees would be removed whole and placed in a treatment yard for disposal. The USDA-Forest Service is projecting the removal of 3.32 tons of unmerchantable material per acre. The estimated cost of this yarding treatment is a little less that $200.00 per acre.

In the USDA - FS Environmental Impact Statement for the Trout –West project, it is planned to use tractors to yard unmerchantable material. The estimated cost to perform this treatment is $116.20 per acre. If an adjustment is added for the treatment required to protect the soils from erosion after tractors are done in an area, the helicopter yarding option is very competitive.

It is strongly recommended that this option be pursued. This technique would allow for the effective treatment of dwarf mistletoe stands on the steeper slopes in the western third of the open space. A dialogue should be established with the local Pikes Peak Ranger District to explore the possibility of sharing the expertise of these forest management treatment contractors.

As the areas of dwarf mistletoe are treated, it would be advisable to attempt to increase the diversity of the conifers within the forest itself. This could be accomplished by favoring both ponderosa pine and white fir. Clearing an area no wider than one tree height around potential seed trees will help the lesser dominant conifers establish a larger presence in the forest stands.

Dry Creek Unit

The eradication of the Canada thistle is the primary concern in this unit. Specific treatment protocols can be found in Appendix 4.

Vegetation treatments should be selective in manner. Dead trees that pose a threat to the general public should be removed. Trees should also be removed for insect or disease control. Other than these types of treatments, disturbance within the unit should be minimized.

Vegetation treatments that abut or affect drainages that flow into Dry Creek should follow the Colorado Forest Stewardship Guidelines to Protect Water Quality; Best Management Practices for Colorado. Of particular interest is the use of streamside management zones. A copy of this guide is included as Appendix 5.

The construction of small pools within the creek bed can begin at any time. These pools can be constructed by creating a rock barrier that will allow a small pool of water to develop behind it during periods of low water. This pool need only be 3-4 inches deep in order to be utilized by wildlife.

The rocks used for construction of these pools should be obtained from the immediate vicinity. Placement of these rocks should be in deep scoured locations within the stream channel. The rocks should be of a sufficient size that they will remain in place during spring runoff or during high precipitation events.

Volunteers might be used to construct these rock pools in conjunction with other volunteer or treatment projects.

The vertical space along the creek could be improved with the addition of Colorado blue spruce or narrowleaf cottonwood trees. As the current condition of the creek banks and stream channel is stable, this activity should only occur when there is damage within the unit or when removed trees require immediate replacement to maintain channel stability.

Implementation Schedule

Disturbed Corridor Zone

Management treatments to control noxious weeds in this zone should commence in the year 2004.

Based upon the federal and state cost share guidelines each chemical application should cost in the vicinity of $20.00 per acre. The total area to be treated is probably two acres in size. However the noxious weed infestation is not continuous and is spread all along the corridor. Therefore the fixed overhead expenses may drive the treatment cost upwards to $100 - $150.00 per acre for each treatment application.

The small populations of Canada thistle that exist within the Dry Creek Unit should also be included in these treatment applications. As these weed populations are found in sensitive water systems, an additional cost may be incurred to treat these locations. This cost could be offset by the relative ease in treating the weed infestation along the utility access road.

After the initial treatment, monitoring of the noxious weeds should be performed bi-annually and spot treatments applied during the inspection. It is anticipated that monitoring may be required for up to five years after the initial control treatments.

Estimated Cost Summary

Year 1: Initial Treatment & Monitoring	$750.00
Year 2: Spot Treatment and Monitoring	500.00
Years 3-5: Monitoring and Spot Treatments	750.00

If chemical treatments exhibit a high level of control after the first season, no cultural practices may need to be applied. There should be sufficient grass seed available to naturally populate treatment locations from the adjacent space to the noxious weed infestations.

Heavy precipitation events and compacted soil conditions along the utility access road may prevent this available seed from forming a sufficient stand density to effectively compete against and suppress the growth of noxious weeds. If this scenario presents itself after the second year, it may be necessary to supplement the natural seed process.

This would entail the application of seed either by hand or mechanical drill and stabilizing the seed bed with some type of mulch material. Costs to perform this activity may range upwards of $315.00 per acre.

The control of musk thistle is expected to be accomplished by the use of volunteers. So the only costs involved will be to provide training, supervision and minor supplies such as bags or buckets to collect the seed heads. The cost of the appropriate percentage of an employee equivalent to organize this activity should be applied as a charge to the maintenance of this park.

As the noxious weeds are being treated, the spoil piles should be contoured, a topsoil cap applied and seeded with native grasses. The estimated cost of this action is estimated to be $6,000.00 dollars. It may be more efficient to perform this activity with existing heavy equipment resources from one of the city's departments in consultation with a landscape architect from the park and recreation department.

Scrub Oak Zone

Restoration should commence in the year 2005. There is approximately eleven acres scheduled for restoration from scrub oak to the ponderosa pine type. In this treatment unit, the oak is to be cut and the resultant slash could be chipped and spread across the site to reduce the short term fire hazard. Another option for slash disposal is to pile the slash and burn it at a later date when conditions permit.

Estimated costs are derived from cost-share programs administered by state and federal agencies.

The cost to cut the oak down is estimated at $300.00 per acre. The cost to chip the slash is also estimated to be $300.00 per acre. In order to reduce the cost of disposing of the oak slash, burning small piles should be considered. This could reduce the cost of slash disposal to $100.00 per acre.

A chemical follow-up treatment of the oak sprouts would cost approximately $100.00 per acre if needed.

Using the estimate acreage of eleven acres, the following cost projection can be made.

Oak Removal	$3,300.00
Slash Disposal by Burning	1,100.00
Chemical Sprout Treatment	1,100.00
Total Cost for Initial Treatment:	$5,500.00

If sufficient natural regeneration occurs, then no further treatments would be required over the next ten years.

If insufficient natural regeneration does occur (<300 seedlings per acre), supplemental planting to reach the desired level must be performed. It is recommended that 350 seedlings be planted per acre to achieve the desired level of stocking.

Containerized planting stock should be utilized in the planting process. While the cost of bare-root stock is decidedly less expensive, the uncertainty of favorable weather conditions to perform the planting could lead to increased mortality and the cost savings would be lost. The summarized costs per acre would be:

Cost of 350 containerized pine seedlings	$350.00
Cost of Labor to Install	175.00
Total Cost per Acre	$525.00

This cost per acre results in a total project cost of $5,775.00. It should be noted here that some level of natural regeneration will occur, so in all likelihood the cost would not be as high. The level of success from natural regeneration can be increased by monitoring the residual seed trees in the treatment area. Cutting treatment should coincide with the maximum seed production of these trees.

This management activity should be performed as soon as is possible in regard to seed production potential of the residual trees. Monitoring the cone production potential should begin in the year 2004 and it is estimated that one-person day will be required to accomplish this on an annual basis until the maximum seed bearing period is identified.

As the seed bearing potential can be identified one year in advance of the seed reaching maturity, the mechanical treatment can be completed in a timely manner. It is anticipated that it may take one ten year cycle to complete this management activity.

Once the initial cycle is completed, the use of prescribed fire should be utilized to maintain an open park-like condition. It is estimated here that this treatment would be required every 15 – 25 years.

The oak treatment for fire mitigation along the southeast border of the open space and the Mahogany Vale at Peregrine, Filing 2 subdivision encompasses approximately 3.25 acres. The same type of treatment as described above should be utilized. As the purpose of this treatment is to reduce the risk of a wildfire leaving the property and damaging neighboring structures, chipping should be used to dispose of the slash.

The cost to treat the entire acreage should cost approximately $1950.00 to complete. This area should be treated in the year 2004 or in the year 2005 at the very latest.

The northeast border will not require any immediate fuel treatment. As the slope approaches the structures uphill from the open space boundary, the scrub oak thins appreciably and will not carry a wildfire uphill. The grasses will be most responsible for fire spread. This fuel should be modified closer to the structures.

An appointment should be made with each landowner that borders the open space to the northeast. Each of these landowners should be informed of their risk of loss to wildfire and what steps they can perform to lower their risk. It is suggested here that the city's Fire Wise Team be solicited to perform this service.

Oak removal to encourage expansion of the conifer islands should not be initiated until all other management activities in all of the zones are completed.

No other specific management treatments are recommended for this zone.

Ponderosa Pine/Scrub Oak Zone

It is recommended that no specific treatments be applied to this zone in the first ten years. The prescribed treatments can be delayed without jeopardizing the future of this zone.

That is not to infer that this zone should be ignored. The threat of attack from mountain beetle is still possible. This area should be monitored on an annual basis for bark beetle activity. This inspection can be conducted during the winter months and any infected trees should be removed by the first of June of the following year.

It is estimated that this inspection process will take no more than one employee day per year.

After year 10, this stand should be treated with the Douglas-fir less than twelve inches in diameter removed. The oak understory should also be cut and removed at the same time. As this stand has excellent access to vehicles, the slash should be chipped and spread across the site.

By year 15, this stand should have a broadcast fire treatment applied. A broadcast burn allows a prescribed fire to burn over a designated area. By utilizing the old road and the hiking trails that cross this zone as potential control lines, it should be very practical to use this area as a field trial.

A prescribed burn plan and a smoke management plan should be prepared and approved prior to any proposed ignition. All air quality standards for the state of Colorado must be met.

The fuel to be treated from a prescribed fire is small diameter material such as needles, cones, dead grasses and woody debris up to three inches in diameter. Coniferous regeneration that is too small in size or too abundant to be cut from the understory is also targeted. The prescribed burn plan should have a goal of consuming 75% of the target fuel. Future applications of fire as a restoration treatment should occur every 15 to 25 years.

Douglas-fir Zone

The Douglas-fir zone is the **second highest priority** for management treatments. This is due to the presence and severity of dwarf mistletoe found in this zone. With a total of 66 acres requiring some level of treatment, it is proposed to spread this work over a period of ten years.

The first entry into the dwarf mistletoe infected areas should be limited to locations that are readily accessible from the existing road and trail system. The first entry should remove any overstory trees with an infection rating of three or greater. The estimated cost of the first-entry tree removal may range from $1,000 to $1,500 per acre.

Any trees with a diameter of six inches or larger should be removed from the site. Any salvage value should be pursued with Casey's Lumber, Inc., a small sawmill operation located outside of Woodland Park. The remaining material should be lopped and scattered to a height no greater than eighteen inches and allowed to decompose over time.

Burning to reduce the fuel load posed by the slash is not recommended where the proximity of steep slopes in excess of 30% are present. The potential for damage from an escaped fire outweighs the savings that might be realized in reducing the fuel load. If the increase in the amount of fuel loading from the treatment of mistletoe infected trees becomes an issue, chipping of the material should be the preferred option. This could add an additional expense of $300 per acre.

Once the initial treatment of the mistletoe infected stands is accomplished, a second entry should be scheduled within five years of the first entry. This second entry will remove any remaining trees that are infected with dwarf mistletoe. Where high recreational values exist such as trail corridors, the mistletoe should be pruned from trees with a rating of less than 2 in order to maintain the maximum amount of tree cover. Creating too large of an opening in the tree canopy may lead to the development of unwanted social trails through treatment locations. Second entry costs may range from $500 to $1,000 per acre.

Dwarf mistletoe infections on slopes in excess of thirty percent can be treated within the current plan timeline. Due to rugged terrain involved in reaching these infections, a sanitation thinning should be performed at the same time. This would involve the removal of trees with poor form or vigor.

Where possible, the main trunk of larger trees (>8" in diameter) should be felled perpendicular to the slope. The intent here is to use the trunk as a sediment/soil trap and reduce naturally occurring erosion. These locations of trapped soils and organic matter provide favorable conditions for natural tree regeneration.

The slash will be lopped and scattered to a height of eighteen inches or less. This type of treatment will increase the severity of the wildfire risk over the short term. It will influence the behavior of a wildfire over the long term. By leaving the slash behind, it will increase the fuel loading of the surface of these extremely steep slopes. At the present time these surface fuels are low in quantity.

The cost to control the dwarf mistletoe and perform a sanitation thinning at the same time may easily exceed $4,000 per acre. Comparable work being performed for wildfire mitigation in Boulder and Jefferson counties finds thinning costs ranging from $2,500 to $3,000 per acre. With the steep slopes involved within the open space, average costs will run higher.

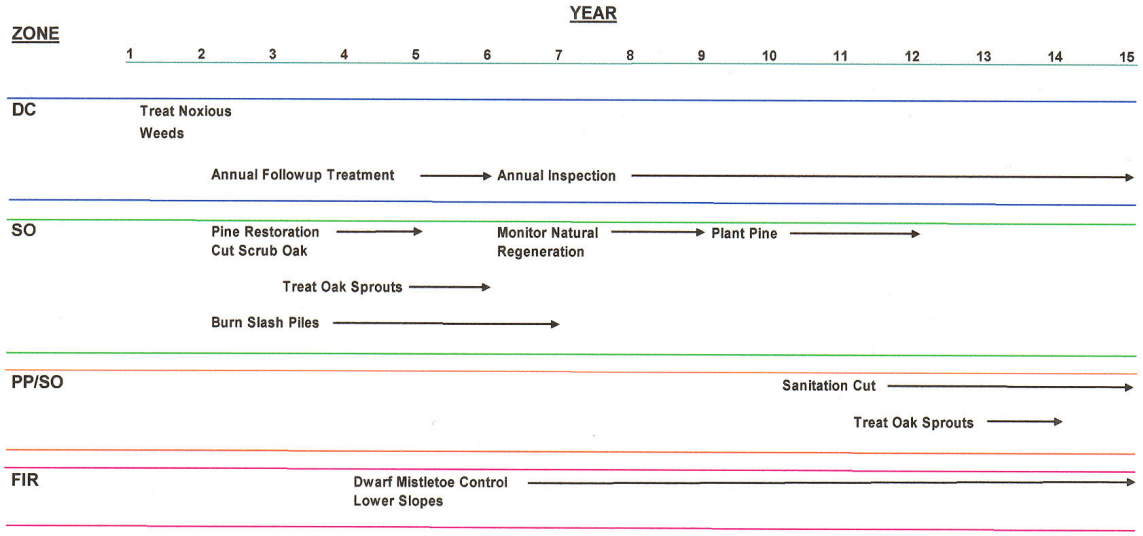
After the initial control rotation has been completed, an annual inspection of the zone should be performed. This inspection should determine any residual infection of dwarf mistletoe. Any infections found should be treated in the following season. These follow-up inspections and treatments should be performed for five years.

Dry Creek Unit

The noxious weed control is the highest priority in this unit. Control activities are included in the disturbed corridor zone implementation schedule.

No other treatments are considered at this time.

ANNUAL TREATMENT SUMMARY



APPENDIX

- **References**
- **Glossary**
- **Noxious Weed Reference Sheets – CSU Cooperative Extension Service**
- **USDA – Forest Service Fire Behavior Models**
- **Colorado Forest Stewardship Guidelines to Protect Water Quality**

Appendix 1 - References

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Appendix 2 - Glossary

Acre : A measurement of land area being 43, 560 square feet, or an area approximately 209 feet square.

Arkose: A sandstone derived from disintegrated granite or gneiss and characterized by fragments of feldspar. An arkosic conglomerate is one in which the fine material, or matrix containing the boulders or pebbles, is arkose.

Basal Area (BA): The cross-sectional area of a tree measured at breast height (4.5 feet above the ground), inclusive of bark and expressed in square feet. Basal area per acre is a common expression of timber density or stocking.

Basal Area Factor (BAF): The number of units of basal area per acre represented by each tree tallied in point or variable plot sampling.

Board Foot: A standard unit of measure for standing timber, logs or lumber equal to a board one foot wide, one foot long and nominally one inch thick.

Canopy: The more or less continuous cover of branches and foliage formed collectively by the crowns of adjacent trees and other woody growth. Layers or different levels may be distinguished within the canopy.

Conservation: The protection, improvement and wise use of natural resources according to principles that will assure their highest economic and/or social utility.

Cord: A unit of measurement of wood, usually used for small wood. A stack of wood containing 128 cubic feet within the outside surfaces. Locally a cord equals approximately 90 cubic feet of solid wood.

Cubic Foot: A unit volume of measurement equal to one foot square by one foot thick.

Decay: Decomposition of wood fiber by fungi; decomposed wood.

Diameter Breast Height (DBH): The diameter of a tree at 4.5 feet above ground level.

Even-aged Stand: A stand in which relatively small age differences exist between individual trees.

Growing Stock Level (GSL): A level of stocking designed to attain a targeted basal area when the stand reaches an average of ten inches or more in DBH.

Reproduction: Young seedlings which have seeded in or sprouted naturally.

Riparian Area: An area identified by the presence of vegetation that requires free or unbound water or conditions more moist than normally found in the area.

Sanitation Cutting: The removal of dead, damaged, or susceptible trees; “to capture” volume before it dies and degrades.

Single Tree Selection: A method of harvesting under an uneven-aged forest management system in which trees are individually selected for harvest.

Site Index: A measure of forest productivity generally expressed as the height in feet of dominant and co-dominant trees of a certain species at a specific index age such as 25, 50 or in the west, 100 years.

Slash: The debris left after logging, pruning, thinning or brush cutting. Slash includes logs, chunks, bark, branches, stumps and broken understory trees and shrubs.

Stand: A community, composed of trees, possessing sufficient uniformity of composition, age, spatial arrangement or condition so as to be distinguished from adjacent communities.

Unit Inventory: A timber sampling system which estimates stand characteristics such as tree species, diameter distribution and log grades on a site specific volume basis for logging, silvicultural and other planning.

Wildfire: An unplanned fire requiring suppression action.

APPENDIX 3

Noxious Weed Information

CSU Service in Action Sheets

- **No. 3.108 – Canada thistle**
- **No. 3.102 – Musk Thistle**
- **No. 3.110 – Diffuse and Spotted Knapweed**
- **No. 3.114 – Biology and Management of the Toadflaxes**

Colorado State University Cooperative Extension
Putting Knowledge to Work

no. 3.108

Canada Thistle

by K.G. Beck [1]

Quick Facts...

- Canada thistle is a creeping perennial that reproduces from vegetative buds in its root system and from seed.
- It is difficult to control because its extensive root system allows it to recover from control attempts.
- Combining control methods is the best form of Canada thistle management.
- Persistence is imperative so the weed is continually stressed, forcing it to exhaust root nutrient stores and eventually die.

Canada thistle (*Cirsium arvense*) is an aggressive, creeping perennial weed that infests Crops, pastures, rangeland, roadsides and noncrop areas. Generally, infestations start on disturbed ground, including ditch banks, overgrazed pastures, tilled fields or abandoned sites. Canada thistle reduces forage consumption in pastures and rangeland because cattle typically will not graze near infestations.

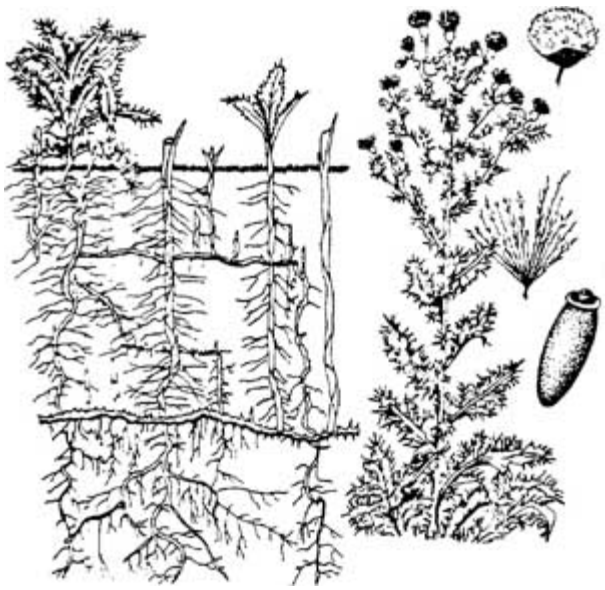


Figure 1: Canada thistle (*Cirsium arvense*).

One plant can colonize an area 3 to 6 feet in diameter in one or two years. Canada thistle grows in a variety of soils and can tolerate up to 2 percent salt content. It is most competitive in deep, well-aerated, productive, cool soils. It usually occurs in 17- to 35-inch annual precipitation zones or where soil moisture is adequate. It is less common in light, dry soils. A survey conducted in 1998 showed Colorado has about 400,000 acres infested with Canada thistle.

Phenology

Emergence. Canada thistle develops from seed or vegetative buds in its root system. Horizontal roots may extend 15 feet or more and vertical roots may grow 6 to 15 feet deep. Canada thistle emerges from its root system in mid- to late spring (late April through May) and forms rosettes (Figure 1).

The greatest flush of root-derived plants occurs in spring, but another flush occurs in fall. A flush can occur anytime during the growing season when soil moisture is adequate. This is particularly a problem when Canada thistle growth is disturbed by tillage or herbicides. This feature can be manipulated to the land manager's advantage.

Plants that germinate from seed do so at about the same time as root-derived shoots. Seedlings grow slowly and are sensitive to competition, particularly if shaded. Canada thistle seedlings develop a perennial habit (the ability to reproduce from their root systems) about seven to eight weeks after germination.

Reproduction and spread. Canada thistle begins to flower in late spring to early summer in response to 14- to 16-hour days. Plants are male or female (dioecious) and grow in circular patches that often are one clone and sex. Female flowers produce a sweet odor and insects readily pollinate different sexed patches up to 200 feet apart.

Canada thistle develops seed sparingly. It may produce 1,000 to 1,500 seeds per flowering shoot. Generally, vegetative reproduction from its root system contributes to local spread and seed to long distance dispersal. Seed may be transported long distances by water, or attached to animals, clothing, farm equipment and other vehicles, and in contaminated crop seed. Also, wind may help disseminate seed, but most often, the feathery pappus breaks off, leaving the seed attached to the parent plant to be disseminated by other means. Seed can remain viable in soil up to 20 years, and deep burial promotes survival longevity.

Canada thistle allocates most of its reproductive energy into vegetative propagation. New shoots and roots can form almost anywhere along the root system of established plants. Tillage segments roots and stimulates new plants to develop. Shoots emerge from root and shoot pieces about 15 days after disturbance by tillage. Small root pieces, 0.25 inch long by 0.125 inch in diameter, have enough stored energy to develop new plants. Also, these small roots can survive at least 100 days without nutrient replenishment from photosynthesis.

Management

The key principle to Canada thistle control is to stress the plant and force it to use stored root nutrients. Canada thistle can recover from almost any stress, including control attempts, because of root nutrient stores. Therefore, returning infested land to a productive state occurs only over time. Success requires a sound management plan implemented over several years.

Cultural control. Grasses and alfalfa can compete effectively with Canada thistle if their growth is favored by good management. Maintain fertility and, if possible, moisture at optimum levels to favor grass or alfalfa growth. Soil analysis can easily determine fertility needs. Be cautious with nitrogen fertilizers, because excess available soil nitrogen may favor weed growth.

These are essential management steps to ensure optimum desirable plant growth and competition. However, competition alone seldom is effective against Canada thistle.

Chemical control. Read the label, follow directions and use precautions. Research at Colorado State University shows that Tordon 22K (picloram), Curtail (clopyralid plus 2,4-D), Transline (clopyralid), Banvel/Vanquish/Clarity (dicamba), 2,4-D and Telar (chlorsulfuron) are effective against Canada thistle. These herbicides are most effective when combined with cultural and/or mechanical control.

Banvel/Vanquish/Clarity, and 2,4-D may be used on pastures, rangeland and non-crop areas. Tordon, Curtail, Telar and Transline may be applied on noncrop areas only. Colorado State University data indicates that Banvel/Vanquish/Clarity or Telar are effective when combined with 2,4-D as a split-season application.

Apply 2,4-D, 2 quarts per acre (A), in spring when Canada thistle is 10 to 15 inches tall, in pre-bud to early bud growth stages. Re-treat in fall with Banvel/Vanquish/Clarity (2 quarts/A) or Telar (1 ounce/A) to re-growth. Use a surfactant (0.25 percent to 0.5 percent v/v) with Telar for adequate control. Banvel/Vanquish/Clarity also may be applied in early spring at 2 quarts/A when Canada thistle is in the rosette stage. Tordon (1 quart/A) or Tordon plus 2,4-D (1 quart + 1 quart/A) is effective whenever Canada thistle is actively growing. Fall applications are especially effective.

Curtail and Transline are effective when applied in spring after all Canada thistle plants have emerged. Apply Curtail (2 to 3 quarts/A) when the oldest Canada thistle plants are entering the bud growth stage and the youngest are in the rosette to bolting growth stages. Apply Transline (2/3 to 1 pt/A) when Canada thistle is in the rosette to bud growth stages. Transline at 1 pt/A also is effective when applied in fall.

Recent research at Colorado State University shows that the performance of Curtail to control Canada thistle can be improved when preceded by two or three mowings. When Canada thistle infestations occur in situations where root growth would be restricted, such as habitats with high water tables, begin mowing when it is 12 to 15 inches tall. Repeat mowings at about one month

intervals. Apply Curtail at 2 to 3 quarts/A in October or about one month after the third mowing. Follow this regimen for two consecutive years.

Mechanical control. Mowing hay meadows can be an effective tool if combined with herbicide treatments. Mowing alone is not effective unless conducted at one-month intervals over several growing seasons. Always combine mowing with cultural and chemical control. Mowing at hay cutting stimulates new Canada thistle shoots to develop from its root system.

In irrigated grass hay meadows, fall herbicide treatments that follow mowing can be an effective management system because more Canada thistle foliage is present after cutting to intercept herbicide. Additionally, root nutrient stores decrease after mowing because the plant draws on them to develop new shoots.

If a Canada thistle infestation exists in a field that will be rotated to alfalfa, control the weed before seeding alfalfa. Alfalfa is an effective competitor only after it is established. It will not adequately establish in a well-developed Canada thistle infestation. A Canada thistle management system can start with crop or grass competition combined with herbicides, with the field rotated to alfalfa when the management plan ends.

Biological control. *Ceutorhyncus litura* is a weevil currently used as a biocontrol agent in Colorado. The female lays eggs underneath the Canada thistle leaves in early spring. Larvae bore into the main leaf vein, then down into the plant's crown area. If the population is high enough, plant death can occur; otherwise Canada thistle is stressed and less vigorous.

Ceutorhyncus alone will not effectively control Canada thistle. It must be combined with other methods to be successful. Combine the weevil with cultural techniques that allow for maximum desirable plant competition. Research to combine *Ceutorhyncus* with herbicides or mowing has not been conducted. Research has shown that biological and chemical controls are compatible for musk thistle. This is most likely true for Canada thistle as well. *Ceutorhyncus litura* is available through the Colorado Department of Agriculture.

Urophora cardui is another biocontrol insect available from the Colorado Department of Agriculture. Females lay eggs on apical meristems of developing shoots. Larvae burrow into shoots. Their feeding triggers huge galls to form that stress the plant, perhaps killing it. Galls that form near the terminal meristems (e.g., where flowers develop) keep the weed from flowering and reduce seed set.

[1]Colorado State University Cooperative Extension weed science specialist and professor, bioagricultural sciences and pest management. Revised 3/03.

Updated Tuesday, April 08, 2003.

Colorado State University Cooperative Extension
Putting Knowledge to Work

no. 3.102

Musk Thistle

by K.G. Beck [1]

Quick Facts...

- Musk thistle is a biennial weed that reproduces only from seed.
- The key to successful musk thistle control is to prevent seed production.
- Apply herbicides such as Tordon, Vanquish/Clarity or 2,4-D to musk thistle rosettes in spring or fall. Apply Ally or Telar up to the early flower growth stage.
- Combine control methods into a management system for best results.

Musk thistle is an aggressive weed of foreign origin that occurs in pastures, rangeland, roadsides and non-crop areas. It is a biennial weed, although occasionally it is an annual. Because musk

thistle reproduces solely from seed, the key for successful management is to prevent seed production.

Germination and seedling establishment are correlated with moisture and light. Thus, more seeds germinate and establish plants in open pastures and other degraded areas.

Vigorously growing grass competes with musk thistle, and fewer thistles occur in pastures where grazing is deferred. However, musk thistle also can become a problem in pasture or rangeland that is in good condition.

Phenology

Seedlings normally emerge early in spring, develop into rosettes and spend the first season in this growth stage. Seedling emergence also can occur in fall. All seedlings grow into rosettes and overwinter in that stage. Rosettes are usually large and compact with a large, corky taproot that is hollow near the crown (Figure 1).

Figure 1: Musk thistle (*Carduus nutans*) L.

Early in spring of the second year, overwintered rosettes resume growth. Shoots begin to elongate (bolt) in late March through May, depending on weather and altitude. Musk thistle flowers and starts to produce seed 45 to 55 days after it bolts.

Musk thistle dies after it sets seed. It spends approximately 90 percent of its life cycle in a vegetative growth stage. Musk thistle's tolerance to most herbicides increases after it bolts.

Reproduction and Spread

Musk thistle is a prolific seed producer. One plant can set up to 20,000 seeds. However, only one-third of the seeds are viable. Musk thistle produces many heads. The terminal, or tallest, shoots flower first, then lateral shoots develop in leaf axils. A robust plant may produce 100 or more flowering heads.

Musk thistle flowers over a seven- to nine-week period. It begins to disseminate seed from a head about two weeks after it first blooms. It is common to observe musk thistle with heads in several stages of floral development and senescence. Thus, musk thistle sets seed over an extended time period.

Most seed is disseminated within the immediate vicinity of the parent plant. This leads to a clumped pattern of seedling development and results in intraspecific competition and mortality. Wind and water are good dissemination methods and seeds are also spread by animals, farm machinery and other vehicles. Less than 5 percent of seed remains attached to the pappus when it breaks off the flowering head and floats away on wind currents.

Management

Cultural control. Maintaining pastures and rangeland in good condition is a primary factor for musk thistle management. To favor pasture and rangeland grass growth, do not overgraze. Fertilize only when necessary and according to soil testing recommendations. To successfully manage musk thistle, prevent seed formation.

Mechanical control. Musk thistle will not tolerate tillage and can be removed easily by

severing its root below ground with a shovel or hoe. Mowing can effectively reduce seed output if plants are cut when the terminal head is in the late-flowering stage. Gather and burn mowed debris to destroy any seed that has developed.

Chemical control. Several herbicides are registered in pasture, rangeland and noncrop areas to control musk thistle. Tordon 22K (picloram), Curtail (clopyralid +2,4-D), Banvel/Vanquish/Clarity (dicamba), 2,4-D, or Banvel/Vanquish/Clarity plus 2,4-D are commonly used. Apply these herbicides in spring or fall to musk thistle rosettes.

Apply Tordon at 0.5 to 1 pint per acre (A), Curtail at 2 quarts/A, Banvel/Vanquish/Clarity at 0.5 to 2 quarts/A, 2,4-D at 1.5 to 2 quarts/A, or Banvel/Vanquish/Clarity plus 2,4-D at 0.5 plus 1 quart/A. Cool temperatures (below 50 degrees F), particularly in fall, may adversely affect 2,4-D control of musk thistle; therefore, use 2,4-D in spring. Tordon is largely unaffected by cool temperatures. Banvel/Vanquish/Clarity can be adversely affected but less than 2,4-D. Banvel/Vanquish/Clarity plus 2,4-D works well in spring or fall. Apply any of these herbicides before musk thistle bolts or seed production still will occur.

Ally-Escort (metsulfuron) or Telar (chlorsulfuron) also can be used. Use Telar in noncrop areas only and Ally-Escort in pastures, rangeland or noncrop areas. Research from Colorado State University and the University of Nebraska shows that Telar or Ally-Escort prevents or dramatically reduces viable seed formation when applied in spring, up to early flower growth stages. The latest time to apply these herbicides is when developed terminal flowers have opened up to the size of a dime.

Apply Telar at 1 ounce/A or Ally-Escort at 0.5 ounce/A. Add a good agricultural surfactant at 0.25 percent v/v^2 to Ally-Escort or Telar treatments or control is inadequate.

Biological control. The musk thistle seed head weevil, *Rhinocyllus conicus*, can be found throughout Colorado. The female deposits her eggs on the back of developing flowers and covers them with chewed leaf tissue. After eggs hatch, larvae bore into the flower and destroy developing seed. The seed head weevil reduces seed production by 50 percent on the average. If used alone, however, it is not an effective management tool. Certain herbicides or mowing can be combined with the seed head weevil if these are used during late flowering stages. This allows the weevils to complete their life cycle and ensures their presence in subsequent growing seasons.

The Colorado Department of Agriculture has established another weevil, *Trichosirocalus horridus*. This weevil attacks the crown area of musk thistle rosettes and kills or weakens the plant before it bolts. This weevil is being distributed throughout Colorado by the Department of Agriculture. It tends to be more effective than the seed head weevil.

Integrating Control Methods

To combine chemical and biological control methods, apply herbicides when they won't interfere with insect development. That is, allow the control insects to complete their life cycle. Or use herbicides in areas that aren't sensitive to their use and biological control in areas where herbicides are impractical or environmentally unsafe.

Cultural methods that favor desirable plant growth can be combined with chemical or biological control by superimposing proper grazing management and seeding.

[1] Colorado State University Cooperative Extension weed science specialist and professor, bioagricultural sciences and pest management. 9/98. Reviewed 3/03. [2]Volume to volume, e.g., a ratio of 1 quart per 100 gallons of spray solution.

Updated Tuesday, April 08, 2003.

Colorado State University Cooperative Extension

Putting Knowledge to Work

no. 3.110

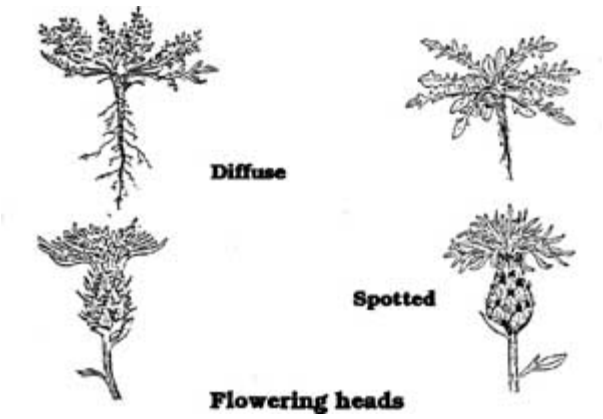
Diffuse and Spotted Knapweed

by K.G. Beck [1]

Quick Facts...

- Diffuse knapweed is a short-lived, non creeping perennial, a biennial, or occasionally an annual that reproduces and spreads solely from seed.
- Spotted knapweed is a short-lived, noncreeping perennial that reproduces from seed and forms a new shoot each year from a taproot.
- Diffuse and spotted knapweeds are readily controlled with herbicides. Unless cultural techniques are used, however, the weeds will reinvade.

Diffuse knapweed (*Centaurea diffusa*) is a short-lived perennial, a biennial, or occasionally an annual. It reproduces and spreads from seed. The plant develops a single shoot (stem), 1 to 2 feet tall, that is branched toward the top. Grazed plants may produce multiple stems. Rosette and lower shoot leaves are finely divided. Leaves become smaller toward the top of the shoot and have smooth margins.



Many solitary flowering heads occur on shoot tips. They are about 1/8 inch in diameter and 1/2 to 2/3 inch long. Flowers usually are white but may be purplish. Involucre bracts are divided like teeth on a comb and tipped with a slender spine that makes them sharp to the touch. Sometimes the bracts are dark-tipped or spotted like spotted knapweed. The long terminal spine differentiates diffuse from spotted knapweed.

Spotted knapweed (*Centaurea maculosa*) looks like diffuse knapweed with some notable exceptions. Spotted knapweed is a short-lived, noncreeping perennial that reproduces from seed (primary means of spread) and forms a new shoot each year from a taproot. The weed produces one or more shoots that are branched and 1 to 3 feet tall. Rosette leaves can be 6 inches long and deeply lobed. Leaves are similar to diffuse knapweed. Lavender to purple flowers are solitary on shoot tips and about the same size as diffuse knapweed flowers. Involucre bracts are stiff and black-tipped. The tip and upper bract margin have a soft, spine-like fringe and the center spine is shorter than others.

Phenology, Biology and Occurrence

Diffuse knapweed seeds germinate in spring or fall or anytime during the growing season following a disturbance, if adequate soil moisture is present. Seedlings develop into rosettes and diffuse knapweed remains as a rosette until it grows to a critical size, then it bolts, flowers, and sets seed. It may take from one to several years for diffuse knapweed to reach the critical size necessary to reproduce by seed.

Diffuse knapweed is native to degraded noncropland (waste places) and seashores from southern Europe to north-central Ukraine. It generally is found on dry, light, porous soils in Europe. Diffuse knapweed appears to occupy similar areas in the United States. Diffuse knapweed will not tolerate flooding or shade and thrives in the semiarid west (generally in 9- to 16-inch precipitation zones). Environmental disturbance (e.g., overgrazed pastures or rangeland, roadsides, rights-of-way, gravel piles, etc.) promotes its invasion.

In Colorado, the worst infestations occur along the Front Range in Larimer, Boulder, Douglas and El Paso counties. Severe infestations also occur in Archuleta and La Plata counties. A 2002 survey conducted by the Colorado Department of Agriculture found 145,148 infested acres of diffuse knapweed and 1,093 infested acres of spotted knapweed.

Spotted knapweed germinates in spring or fall. Perennial plants resume growth in early spring and bolt at approximately the same time as diffuse knapweed. Flowering occurs through the summer into fall.

Spotted knapweed is native to central Europe, where it is found in light, porous, fertile, well-drained and often calcareous soils in warm areas. It occupies dry meadows, pastureland, stony hills, roadsides, and the sandy or gravelly floodplains of streams and rivers. Spotted knapweed tolerates dry conditions, similar to diffuse knapweed, but survives in higher moisture areas as well (e.g., it thrives in the wetter conditions of the western Montana mountains). Spotted and diffuse knapweed infestations often occur together in Colorado.

Spotted knapweed infestations are not as severe in Colorado as diffuse knapweed. However, this weed spreads rapidly. For example, spotted knapweed was first observed in Gallatin County, Montana, in the 1920s, but is now found in all Montana counties. Today, over 4.7 million acres are infested.

Management

Diffuse and spotted knapweed can be managed similarly. They are readily controlled with herbicides. However, the weeds will reinvade unless cultural techniques are used.

Chemical control. Research conducted at Colorado State University indicates that Tordon 22K (picloram) at 1 to 2 pt/A, Transline (clopyralid) at 0.67 to 1 pt/A, Curtail (clopyralid + 2,4-D) at 4 to 6 pt/A, or Banvel/Vanquish/Clarity (dicamba) at 1 to 2 pt/A control diffuse knapweed. Tank mixes of Banvel/Vanquish/Clarity plus 2,4-D at 1 pt + 2 pt/A or Banvel/Vanquish/Clarity plus Tordon 22K at 1 to 2 pt + 0.5 to 1 pt/A or Tordon plus 2,4-D at 0.75 pt + 2 pt/A all control diffuse knapweed. These tank-mixes may save money and reduce grass injury resulting from higher use rates of a single herbicide.

Spotted knapweed and diffuse knapweed generally occupy the same areas in Colorado, so the same herbicide treatments can be applied. Weed scientists at Montana State University indicate that 1 pt/A of Tordon (0.25 lb) controls spotted knapweed for two to three years, but the weed will reinvade the area unless other management techniques are used.

Cultural control. If desirable grass competition is evident in diffuse or spotted knapweed stands, judicious herbicide application that does not injure grasses may allow them to compete effectively with the weeds. Irrigation (where possible) may help stimulate grass competition in these cases. However, infested rangeland or pastures often are degraded, allowing knapweed invasion, and herbicides alone will not restore the land to a productive state. Seeding suitable perennial grasses is necessary to prevent weed reinvasion.

Biological control. Many insects are being evaluated for biological control of diffuse and spotted knapweeds. Researchers at Montana State University believe it will take a complex of insects (perhaps 12) to reduce diffuse and spotted knapweed populations.

Several insects are available in Colorado, from the Colorado Department of Agriculture. The seedhead flies *Urophora affinis* and *U. quadrifasciata* have been released in many Front Range counties. These Insects cause plants to produce fewer viable seeds and abort terminal or lateral flowers.

Root-feeding insects may have a more detrimental effect on knapweed populations than seed-feeding ones. Larvae of the diffuse knapweed root beetle (*Sphenoptera jugoslavica*) feed in the roots of diffuse knapweed. Larvae of the yellow-winged knapweed moth (*Agapeta zoegana*) feed and the knapweed root weevil (*Cyphocleonus achates*) in the roots of both knapweed species.

Livestock (sheep, goats, cattle) will eat diffuse and spotted knapweed. Recent research completed by Colorado State University shows that cattle grazing diffuse knapweed twice in spring decreased seed set by 50 percent and tumbling off-site over winter by 15 percent. Cattle were managed to achieve 50 percent utilization of pasture and were allowed to graze at two 10-day intervals when diffuse knapweed was bolting and about 6 to 12 inches tall.

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Biology and Management of the Toadflaxes

by K.G. Beck. [1]

Quick Facts...

- Yellow toadflax (*Linaria vulgaris*) and the Dalmatian toadflaxes (*Linaria dalmatica and Linaria genistifolia*) are invasive, perennial weeds that are noxious in Colorado and other western states.
- Seeds of yellow toadflax germinate and emerge in early to mid-May while Dalmatian toadflax seeds may germinate and emerge earlier, especially on south or southeast facing slopes.
- Dalmatian toadflax may be controlled with Tordon 22K at 2 pt/A sprayed at flowering or in fall. Yellow toadflax (*Linaria vulgaris*) and the Dalmatian toadflaxes (*Linaria dalmatica and Linaria genistifolia*) are invasive, perennial weeds that are noxious in Colorado and many other western states. Toadflax invasion is favored by disturbance and they invade degraded areas such as roadsides, abandoned lots and fields, gravel pits, clearings, and overgrazed rangeland. In Colorado, these weed species are found at elevations from 5,000 feet to over 10,000 feet. Yellow toadflax in particular has spread into high mountain valleys and parks. Yellow toadflax infests 40,800 acres in Colorado and Dalmatian toadflax infests 34,200 acres.

Origin and History

The toadflaxes have a storied past and a long relationship with humans. Dalmatian toadflax is native to the Mediterranean region. Broad-leaved Dalmatian toadflax (*L. dalmatica*) has been cultivated as an ornamental for at least 400 years. It was introduced into the western U.S. as an ornamental in 1874. The majority of Dalmatian toadflax infestations in the west are broad-leaved Dalmatian toadflax; however in its native Eurasian habitat, narrow-leaved Dalmatian toadflax (*L. genistifolia*) is more widespread, indicating its potential to also invade and become widely dispersed in the U.S. Narrow-leaved Dalmatian toadflax currently infests several areas in western Oregon, northwestern Washington, British Columbia, and possibly in Colorado.

Yellow toadflax is native to south-central Eurasia where it was used for fabric dyes and for medicinal purposes. It was imported into North America in the late 1600s as an ornamental and for folk remedies. It was widely distributed in North America by the mid 20th century. Unfortunately in states where yellow toadflax is not noxious, it still is sold by some nurseries as "butter and eggs" or as "wild snapdragons."

Figure 1. YELLOW TOADFLAX, butter-and-eggs, wild snapdragon (*Linaria vulgaris Mill*.). Noxious. Figwort family. This introduced creeping perennial is an escaped ornamental that reproduces by seed and extensive horizontal roots. Stems are smooth, erect, leafy, often in clumps, and 1 to 2 1/2 feet tall. Numerous pale green leaves are alternate, narrow, pointed at both ends, and 2 1/2 or more inches long. Flowers resemble those of cultivated snapdragon; each has a spur extending below from the lower lip of the corolla. They are about 1 inch long, bright yellow with a bearded, orange throat and occur in terminal, somewhat elongated clusters with the youngest flowers at the tip. The fruit is a brown, globe-shaped, two-celled capsule, 1/4 inch in diameter containing many seeds. Seeds are small, round, rough, flattened, with a papery, notched circular wing, dark brown, and about 1/12 inch in diameter. It is a persistent, aggressive invader in Colorado from 6,000 to 8,500 feet mostly on the Western Slope.

BIOLOGY

Germination and Emergence

Seeds of yellow toadflax germinate and emerge in early to mid-May while Dalmatian toadflax seeds may germinate and emerge earlier especially on south or southeast facing slopes. In Washington, Dalmatian toadflax seedlings on south facing slopes usually emerge in early to mid-March. First year Dalmatian toadflax plants often produce prostrate shoots in fall that survive into the following spring. Mature Dalmatian toadflax may produce prostrate shoots, but to a lesser extent, and these typically die before winter and shoots emerge the following spring from roots. Yellow and Dalmatian toadflax shoots that grow from roots emerge as early as mid-March along the Front Range in Colorado, but vegetative shoot emergence may not begin until mid- to late June at 9,000 feet to 10,000 feet. In Canada, vegetative shoots begin to emerge when soil temperatures range from 42 to 50 F.

Root growth

Seedling root develop is slow and represents a life stage vulnerable to control attempts

and plant competition. Disturbance promotes toadflax invasion and may be necessary for establishment to occur. However once established, toadflaxes readily spread into adjacent non-disturbed areas. Much of this spread is by vegetative means, reflecting a vigorously-growing root system. Dalmatian toadflax roots may grow 20 inches deep or more nine weeks after seedlings have emergedand have vegetative buds that give rise to new shoots. Patch expansion can be dramatic. In Colorado, Dalmatian toadflax shoot density increased over 1,200 percent in six years at one location and 190 percent over three years at another. Yellow toadflax seedlings produce vegetative shoots from root buds two to three weeks after germination. Mature toadflax have well-developed and extensive root systems. Dalmatian toadflax roots may penetrate the soil 4 feet to 10 feet and lateral roots may extend 10 feet from the parent plant; while yellow toadflax roots grow 3 feet deep or more with lateral roots that may extend several yards.

Flowering

Dalmatian toadflax typically flowers begining in late May or June in Colorado and may continue until fall, particularly if moisture is not limiting. Yellow toadflax begins to flower when shoots are from 16 to 24 inches tall, mid- to late May along the Front Range in Colorado, although at higher elevations (9,000 feet or more), flowering may not begin until late July. Yellow toadflax may not flower until fall under drought conditions. Yellow toadflax shoot phenology in any given patch may range from vegetative to flowering to seed set, depending on the time of season and environmental conditions (particularly moisture). This contributes to management difficulties.

MANAGEMENT

All toadflax species are very difficult to control and management plans should integrate as many strategies as possible to increase potential for success. Assess the condition and composition of the existing plant community in an infested area then determine the approximate composition of the desired plant community needed to achieve land management goals and objectives. Create a management plan that combines various control strategies to foster development of the desired plant community.

Chemical and Cultural Management of Dalmatian Toadflax

Dalmatian toadflax may be controlled with Tordon 22K at 2 pt/A sprayed at flowering or in fall. In Colorado, rates of 2, 4, and 8 pt/A of Tordon were compared and control longevity was greatest from the 2 pt rate, apparently because competition from crested wheatgrass was maintained. Researchers in Wyoming treated Dalmatian toadflax in early September, 1994, with Tordon at 2 pt/A, then seeded the following year in April or August with ‘Hycrest’ crested wheatgrass, ‘Luna’ pubescent wheatgrass, ‘Critana’ thickspike wheatgrass, ‘Bozoisky’ Russian wildrye, or ‘Sodar’ streambank wheatgrass. The combination of spraying and seeding competitive grasses controlled Dalmatian toadflax better than spraying alone. Three years after treatments were started, control of Dalmatian toadflax ranged from 61 percent to 86 percent where grasses were seeded in April and from 76 percent to 95 percent from the August seeding, compared to no control from spraying alone.

Chemical Control of Yellow Toadflax

Yellow toadflax appears to be more difficult to manage than Dalmatian toadflax. In Colorado, control from Tordon applied at flowering has been most consistent and typically, 4 pt/A is recommended. Yellow toadflax usually recovers from a single application. For example, Tordon applied at 4 or 8 pt/A controlled 13 percent and 69 percent of yellow toadflax three years after treatments were applied. Other research conducted in Colorado suggests that yellow toadflax control may be improved if Tordon is applied over three consecutive years, but control varied with location. In one experiment conducted at high altitude (Camp Hale; elevation approximately 10,000 feet), 4 pt/A of Tordon applied at flowering for three consecutive years decreased shoot density to zero. However, the same treatment applied for three years at two other locations (White River drainage, elevation approximately 8,500 feet) controlled 69 percent and 35 percent of yellow toadflax. Telar also may be used to control yellow toadflax in non-crop areas. In an experiment conducted in Middle Park near Parshall, Telar at 1.25 ounce/A applied during flowering or in fall controlled 84 percent of yellow toadflax one year later.

Escort, 2,4-D amine, Banvel, and Paramount controlled from 5 percent to 24 percent of yellow toadflax one year after single treatments were applied at flowering. Plateau showed some potential to control yellow toadflax in another Colorado experiment where 8 fluid ounces per acre applied once in fall controlled 59 percent of yellow toadflax one year later. While this level of control is unsatisfactory, sequential treatments may increase control but experiments must be conducted to test this hypothesis.

Figure 2: DALMATION TOADFLAX [*Linaria dalmatica* (L.) Mill. = *Linaria genistifolia* ssp. *dalmatica* (L.) Maire & Petitmengin]. Noxious. This differs from yellow toadflax principally in being larger and having differently shaped leaves. Clumps of stems are 3 to 4 feet tall. Waxy leaves are broad, ovate, sometimes heart shaped and upper leaves clasp the stem (an important difference). Seeds are irregular in shape, angular, somewhat flattened, thin-edged, strongly netted, tan-gray and 1/24 to 1/16 inch across. It is not as common, but is more aggressive than yellow toadflax. It is reported in various parts of the state from 5,000 to 6,500 feet.

Mechanical and Chemical Control of Yellow Toadflax

Mowing combined with spraying Tordon did not improve control in an experiment conducted near Hesperus, Colorado. Yellow toadflax was mowed three times per year then treated with Tordon at 4 pt/A in fall for two consecutive years and compared to Tordon applied at 4 pt/A at flowering also for two consecutive years. Yellow toadflax control was the same (85 percent) whether Tordon treatments were combined with mowing or not.

Biological Control of Toadflaxes

Several classical biocontrol agents are available to use against toadflaxes. However, the success of these agents remains largely unknown. A defoliating moth (*Calophasia lunula*), an ovary-feeding beetle (*Brachypterolus pulicarius*), and two-seed capsule-feeding weevils (*Gymnaetron antirrhini and G.netum*) have been released in the U.S. and

should help decrease seed production.

A stem-boring weevil (*Mecinus janthinus*) and a root-boring moth (*Eteobalea intermediella*) also were released in Canada and the U.S. to control all species of toadflax. These species may help to control shoots and seed production as well as decrease root vigor, but data are unavailable to document their effects. Several of these classical biocontrol agents are available from the Colorado Department of Agriculture Insectary in Palisade. Very few published studies are available to determine whether grazing by livestock will effect any control of Dalmatian or yellow toadflax.

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Appendix 4

Wildfire Behavior Fuel Models

Fuel Model #6 – Brush
Fuel Model #9 – Trees

Fire Behavior Fuel Model 6

Fires carry through the shrub layer where the foliage is more flammable than fuel model 5, but this requires moderate winds, greater than 8 mi/h (13 km/h) at mid-flame height. Fire will drop to the ground at low wind speeds or at openings in the stand. The shrubs are older, but not as tall as shrub types of model 4, nor do they contain as much fuel as model 4. A broad range of shrub conditions is covered by this model. Fuel situations to be considered include intermediate stands of chamise, chaparral, oak brush, low pocosin, Alaskan spruce taiga, and shrub tundra. Even hardwood slash that has cured can be considered. Pinyon-juniper shrublands may be represented but may overpredict rate of spread except at high winds, like 20 mi/h (32 km/h) at the 20-foot level.

The 1978 NFDRS fuel models F and Q are represented by this fuel model. It can be considered a second choice for models T and D and a third choice for model S. Photographs 15, 16, 17, and 18 show situations encompassed by this fuel model.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre	6.0
Dead fuel load, ¼-inch, tons/acre	1.5
Live fuel load, foliage, tons/acre	0
Fuel bed depth, feet	2.5

Photo 15. Pinyon-juniper with sagebrush near Ely, Nev.; understory mainly sage with some grass intermixed.

Photo 16. Southern hardwood shrub with pine slash residues.

Photo 17. Low pocosin shrub field in the south.

Photo 18. Frost-killed Gambel Oak foliage, less than 4 feet in height, in Colorado.

Fire Behavior Fuel Model 9

Fires run through the surface litter faster than model 8 and have longer flame height. Both long-needle conifer stands and hardwood stands, especially the oak-hickory types, are typical. Fall fires in hardwoods are predictable, but high winds will actually cause higher rates of spread than predicted because of spotting caused by rolling and blowing leaves. Closed stands of long-needled pine like ponderosa, Jeffrey, and red pines, or southern pine plantations are grouped in this model. Concentrations of dead-down woody material will contribute to possible torching out of trees, spotting, and crowning.

NFDRS fuel models E, P, and U are represented by this model. It is also a second choice for models C and S. Some of the possible field situations fitting this model are shown in photographs 25, 26, and 27.

Fuel model values for estimating fire behavior

Total fuel load, < 3-inch dead and live, tons/acre	3.5
Dead fuel load, ¼-inch, tons/acre	2.9
Live fuel load, foliage, tons/acre	0
Fuel bed depth, feet	0.2

Photo 25. Western Oregon white oak fall litter; wind tumbled leaves may cause short-range spotting that may increase ROS above the predicted value.

Photo 26. Loose hardwood litter under stands of oak, hickory, maple and other hardwood species of the East.

Photo 27. Long-needle forest floor litter in ponderosa pine stand near Alberton, Mont.

Appendix 5

Colorado Forest Stewardship Guidelines
To
Protect Water Quality

Best Management Practices for Colorado